The Poor Law versus the Positive Check: Living Standards and Mortality in England since the Middle Ages.

Morgan Kelly and Cormac Ó Gráda*

15th April 2009

Abstract

Existing studies find surprisingly little connection between living standards and mortality in England, but go back only to the sixteenth century. This paper uses records of property transfers to extend estimates of mortality back to the mid-thirteenth century and finds, by contrast, that deaths at all levels of society, from poor tenants to wealthy nobles, were strongly affected by harvests. In other words, a strong positive check operated through the spread of epidemic disease, creating clear incentives for societies to evolve institutions to mitigate the impact of bad harvests. The weakening link between harvests and deaths in England (with the revealing exception of London) coincides with the evolution of a national system of poor relief, and suggests that government action played a large role in the disappearance of the positive check.

1 Introduction.

To Laslett's (1965) famous question "Did the peasants really starve?", the current answer is a fairly unambiguous "No". In England, where reliable population estimates go back to the mid-sixteenth century, bad harvests increased deaths somewhat until the early seventeenth century, but their impact then vanishes. What surprises us it that nobody seems to find this very surprising: the assumption appears to be that living standards in seventeenth and eighteenth century England were simply too high for anyone to starve.

However, while average living standards in England were high by the modest standards of the time, a large fraction of the population still lived in deep poverty. Gregory King estimated that one fifth of England's population in 1688 had annual incomes of £2, placing them on the edge of biological survival (Allen, 2008, 953). In an era when annual rises in wheat prices of 20 per cent were not unusual, it is hard to see how bad harvests would not have been followed by marked increases in mortality.

*Very preliminary.

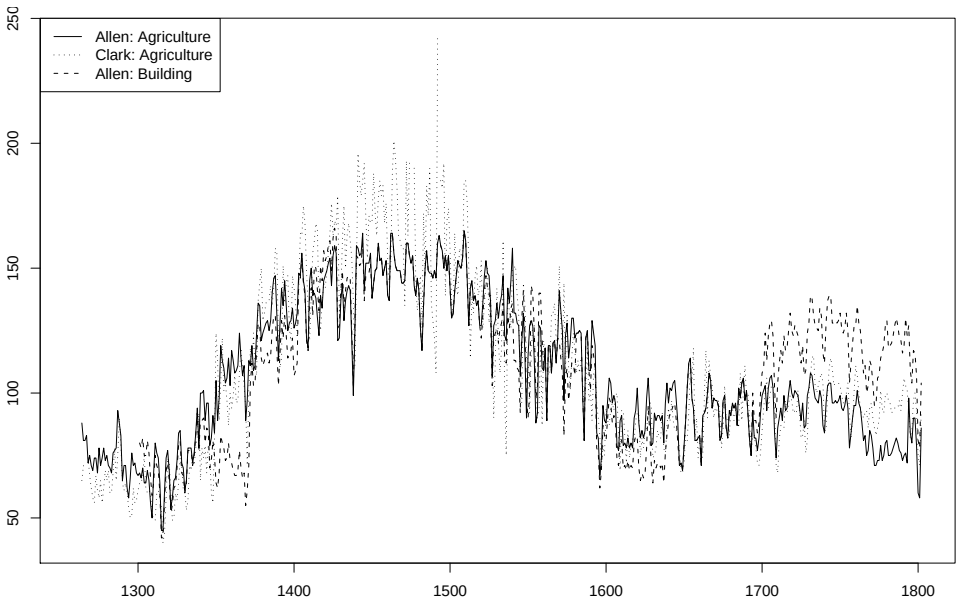

Figure 1: Real wage of labourers in the south of England, 1264–1802.

To understand the link between living standards and mortality, this paper begins by extending estimates of mortality back to the middle ages. Where existing studies look at the three hundred years after the mid-sixteenth century, we go back three hundred years earlier to the mid-thirteenth century. Although direct records of deaths from this time do not exist, we can infer mortality at different levels of society from records of property transfers. We then look at how deaths varied with living standards by using real wage reconstructions, and the the detailed records of harvest yields that survive from medieval manors.

Our results are striking: in the eighty years before the arrival of the Black Death in late 1348, poor harvests were deadly at all levels of society from unfree tenants to the nobility. The effect was not instantaneous: a bad harvest had little immediate impact on mortality, but deaths rose sharply in the following year, with nobles showing the same increase as tenants.

How are we to explain why poor harvests were so lethal before the Black Death but had little impact from the sixteenth century onwards, despite standards of living that were not very much higher or less volatile (see Figure 1)? To understand why the positive check first weakened and then disappeared, we first must understand how it operated.

In textbook Malthusian models, such as Clark (2007*a*), a fall in living standards causes increased mortality; but there is little discussion of the exact mechanism that causes deaths to rise. The implicit assumption is that the poor fade away through starvation. However, it is only with improved public health in the twentieth century that people begin literally to starve to death: before this most famine mortality was due to epidemic disease (Mokyr and Ó Gráda 2002, Ó Gráda 2007).

That poor harvests were followed by epidemics does not appear to be due directly to hunger—the connection between nutritional status and immune functioning is not straightforward, with malnourishment increasing susceptibility to some diseases but not others (Chandra, 1996)—but to increased vagrancy. As people took to the roads in search of work or charity, the combination of malnutrition, poor hygiene, exposure to the elements, and psychological stress turned them into both victims and vectors of contagious disease. As a result, while mortality of the very poor rose immediately after a poor harvest, the main impact occurred one or two years later as epidemic illness spread through the general population.

With bad harvests leading to vagrancy, disease, and social disorder, governments had a clear incentive to ameliorate their impact, but the only state sufficiently well organized to act decisively was England. Historians divide English efforts at poor relief into two broad stages: at first a reliance on interventions in grain markets from the late sixteenth century, supplemented by municipal relief in larger cities and extensive private charity; and then a national system of parish poor rates that appeared in the 1620s and endured for two hundred years (Walter 1989, Leonard 1900).

Against the existing view of pre-industrial economies as passive victims of iron Malthusian processes, it would appear instead that societies not only had the incentive, but sometimes also the ability, to alter their death rates through public and private charity. In other words, living standards were not the sole determinant of mortality: institutions also mattered. As Sen (1981) has famously argued, starvation is as much a matter of politics as of food supply. In the medieval period that is our focus here, there was little extra charitable assistance to cope with crises, and poor harvests caused heavy and prolonged mortality. During the late sixteenth and early seventeenth centuries, increased provision of charity softened the impact of bad harvests; and after 1630 local poor relief and quarantining of infected families was, usually, sufficient to prevent episodes of dearth transforming into national epidemics.

The alternative explanation for declining crisis mortality after the sixteenth century is that it simply reflects higher living standards. However, looking at London, where wages were considerably higher than the rest of England, for the period 1648–1750, we find a continued strong link between harvests and mortality. That the positive check endured in London for over a century after it had largely vanished in poorer rural areas is consistent with the looser organisation of its public charity, and the tendency of the poor to flock there in search of work after poor harvests.

In reconstructing medieval death rates, we rely on three datasets of property transfers. Our first consists of over 12,000 entry fines paid by tenants of the Bishops of Winchester to inherit land from 1263 to the Black Death in 1349 compiled by Page (2003). The second, compiled by Campbell (2005), is the 1,800 or so nobles who died between 1300 to 1349 without leaving adult heirs and whose property therefore reverted to the crown. The third, compiled by Gottfried (1978), are approximately 15,000 wills processed by the courts of the Bishops of Norwich from 1430 to 1480.

This paper draws together three literatures that have existed almost independently of each other: those on living standards and population growth after the sixteenth century; on medieval mortality; and on the evolution of the English Poor Law. The monumental reconstruction of English population after 1541 from parish records by Wrigley and Schofield (1981) allowed the interaction of living standards and population to be studied in detail. Beginning with Wrigley and Schofield (1981, 412–417) and Lee (1981), and continuing to Lee and Anderson (2002) who survey the intervening literature, nobody finds evidence of a positive check after the early seventeenth century. However, what is notable about these all these studies is that they do not go on to ask why the positive check was so small, and whether state intervention had anything to do with this.

Death rates in medieval England have been studied by Razi (1980) and Ecclestone (1999) for the fourteenth century; and by Gottfried (1978), Hatcher (1986), and Hatcher, Piper and Stone (2006) for the fifteenth. However, these authors restrict themselves to describing patterns of mortality and do not examine its possible connection with living standards. The classic exception is Postan and Titow (1959) who looked at the relationship between harvests and mortality on five Winchester manors, but their use of heriots (where the lord was entitled to a dead tenant's best beast) to measure mortality has been heavily criticised by subsequent authors: for a summary see Nightingale (2005, 40–43).

Classic historical discussions of the English Poor Law are Leonard (1900) and Slack (1989). Although the concern of most recent historical study, surveyed by Hindle (2004), is with the micro-politics of the Poor Law, there is increasing interest in its effectiveness as shown by the survey of Smith (2008). Most economic historians focus on the late eighteenth century and after (for example Boyer (1989) and Lindert (2006)); but two notable exceptions that look at the evolution and effectiveness of early poor relief are Walter (1989) and Solar (1995), while Post (1976) argues that variations in European death rates can be explained by different levels of public charity and Fogel (1992) links the absence of English mortality crises after the sixteenth century with the development of public charity.

However, the first author to share our reservations about the crude Malthusian model, where mortality is determined by real wages independently of social institutions, was Thomas Malthus. In *An Investigation of the Cause of the Present High Price of Provisions* (1800) Malthus noted how poor harvests across northern Europe in 1799 had caused near famine in Scandinavia, but no more than hardship in England. Malthus, an opponent of public welfare provision in general, conceded that the English "system of the poor laws... in the present scarcity has been advantageous to the country."

The rest of the paper is as follows. Section 2 shows similar patterns of mortality among tenants and nobles in the eighty years before the Black Death, while Section 3 finds that this mortality is strongly predicted by the harvest in the preceding year. Section 4 by contrast finds little connection between living standards and mortality during the recurrent epidemics of the fifteenth century. To

contrast our medieval results with the intensively studied period after the mid-sixteenth century, Section 5 shows how the positive check waned after the sixteenth century, while Section 6 suggests that the weakening impact of harvests on mortality was due to the creation of a national system of poor relief, and contrasts the continued impact of harvests on London mortality after the mid-seventeenth century with the absence of an effect elsewhere.

2 Mortality before the Black Death: Tenants and Nobles.

In this section we use records of property transfers before the Black Death to look at mortality at opposite ends of the social spectrum: among unfree tenants, and the nobility.

2.1 Mortality among tenants.

On medieval estates, unfree tenants had to pay a fine at the manorial court to transfer tenancy of land, and the records of these payments survive in large numbers. A typical account roll entry, for the manor of Downton in 1325, reads "And for 30 shillings from Isabella, who was Roger's le Muleward wife, to retain one messuage and half-virgate of land [i.e. a cottage and about 20 acres] in Downton which belonged to the said Roger her husband." Titow (1969, p. 123) The fines paid on each manor of the large estates of the Bishops of Winchester in the south of England between 1263 and the arrival of the Black Death in 1349 have been compiled by Page (2003), who was interested in the growth of land transfers between unrelated individuals as evidence of the emergence of a peasant land market. By counting the annual number of these transfers that Page lists as inheritances, we can see how strongly deaths responded to harvest yields and earlier mortality.[1]

We have records of 12,378 inheritances on 77 manors whose annual totals are plotted in Figure 2. Gaps occur in years when there was no bishop. The accounting year started after the harvest, on 29 September (Michaelmas), and manorial courts where fines were paid usually met only a few times a year, so some of the inheritances recorded correspond to deaths in the previous calendar year. The number of inheritances shows two spikes where we would expect them: in 1317 at the peak of the Great Famine, and in 1349, the first year of the Black Death. Inheritances do not shows a trend, which suggests that the relevant population of tenants was approximately constant, although total population probably fell by around 10 per cent during the Great Famine (Kershaw, 1973).

We can gauge the social level of the deceased roughly from the size of the entry fines their heirs paid. To be a middling farmer required about a half-virgate of land which, in the early fourteenth century, commanded an entry fine of at least 30 to 40 shillings and often considerably more. This corresponds to the largest 10 to 15 per cent of fines in our sample, where the median fine after

[1]By measuring mortality directly by inheritances, we avoid the potential problem with heriots encountered by Postan and Titow (1959).

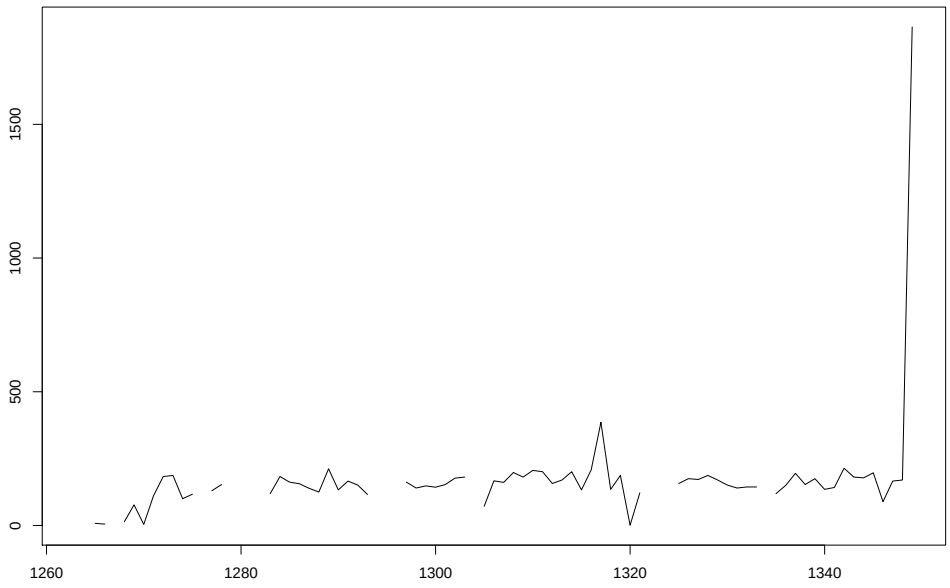

Figure 2: Number of inheritances on the Winchester manors, 1263–1349.

1300 is 7.5 shillings. Typical estimates for early the fourteenth century are that about about half of all tenants owned more than a quarter virgate, the bare minimum for subsistence (Titow, 1969, 78–81). In other words, most tenants in our sample are smallholders, many with too little land to support themselves and having to work for wealthier farmers.

The manors in our sample vary considerably in number of tenants, and in the continuity of their records. Before 1349, the 10 largest manors accounted for roughly 50 per cent of recorded inheritances, and the largest 20 for 70 per cent, and these large manors have almost continuous records. By contrast, records for the smallest manors are fragmentary. For all manors there are three problematic periods of data. While most large manors in most years always report some inheritances, before 1269 most large manors report none: there is clearly severe under-registration. The same occurs in 1323, a year in the middle of a 4 year break in records when many larger manors do not furnish returns; and to a lesser extent in 1305.

2.2 Mortality before the Black Death: Nobles.

The English nobility were legally tenants of the King which meant that when a noble died without children, or those children were minors, their land was supposed to revert to the crown. To determine the value of the property and the existence of possible heirs, an Inquisition Post Mortem was carried out within weeks of the death, usually by neighbouring nobles. The records of all 1,819 surviving Inquisitions from 1300 to 1349 were used by Campbell (2005) to assess the income of the

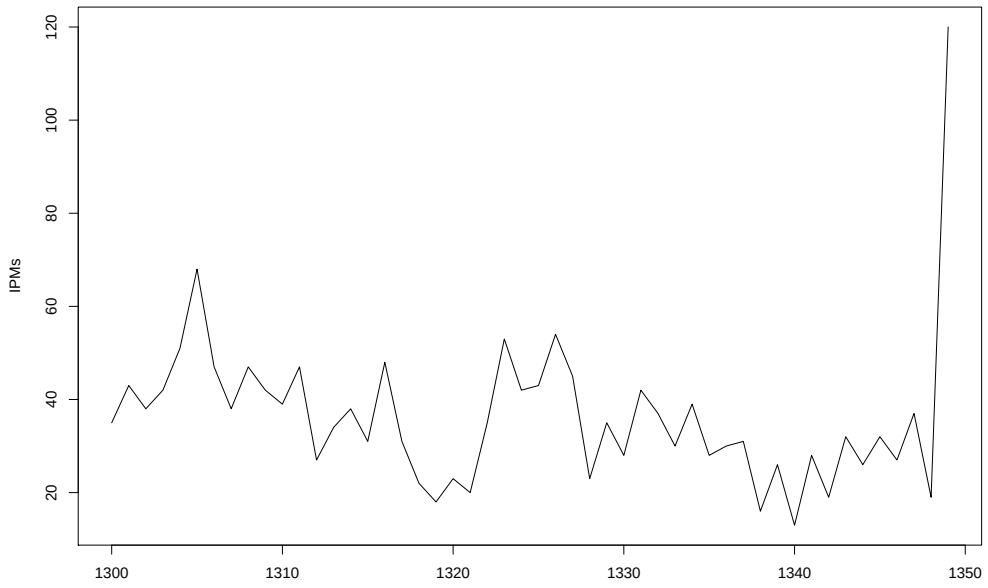

Figure 3: Number of Inquisitions Post Mortem, 1300–1349.

English nobility, and we use his numbers here as a proxy for annual deaths among the nobility.[2] Again, because we are looking at a tenurial series, the number of nobles will remain reasonably constant even if population falls, so death rates will move in line with numbers of deaths if the series is accurate.

This proxy is clearly imperfect: reversion of land to the crown was effectively a tax on the most powerful and potentially dangerous elements of society, and its collection relied on the cooperation of the local nobility.[3] It is possible that in periods of weak central authority, such as the reign of Edward II (1302–1327), numbers of IPMs may underestimate deaths of nobles without adult heirs.

Figure 3 plots the numbers of inquisitions each year. Immediately apparent is the absence of a serious spike at the peak of the Great Famine in 1317 which suggests serious under-registration in that year.

2.3 Death the Leveller.

We have data on mortality from opposite ends of society, one for the very rich, the other for the very poor. We expected that the two series would be very different because of measurement error

[2] Nash (1980) reports the number of IPMs for Wiltshire from 1242–1377, but the annual numbers are small (usually around 4 or 5) and poorly correlated with the numbers here.

[3] Nobles were also at risk of death in battle, but the risk was low at this time: in Rosenthal's (1973) sample of peers, fewer than 5 per cent of those born in the early fourteenth century died violently, compared with one third a century later. The only major battle of this period, Bannockburn in 1314, does not stand out in Figure 6.

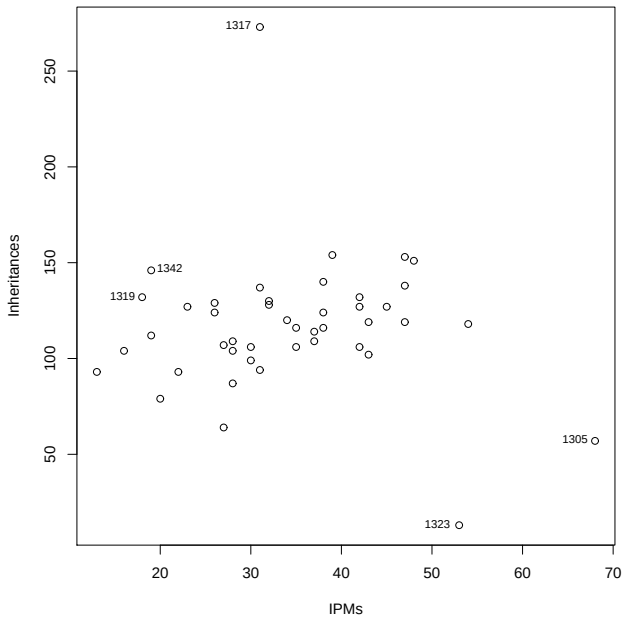

Figure 4: Number of IPMs versus Winchester inheritances, 1300–1348.

in each; and because of the different mortality experiences in the two groups. In fact, they turn out to be closely correlated.

As Figure 4 shows, peasant mortality measured by inheritance fines is strongly linked with mortality of nobles measured by IPMs with the exception of three years where we already suspect under-counting: 1317 for nobles, and 1305 and 1323 for tenants.

This correlation between two series constructed in entirely different ways shows two things. First, that both series are reasonably accurate measures of deaths. The Winchester manors were tightly administered, and we can be fairly confident that there was little evasion of entry fines. That the IPM series matches closely suggests that enforcement of royal rights over nobles' estates, outside the famine year of 1317, was fairly uniform throughout the period, and is a good proxy for the deaths of nobles.

Secondly, that nobles were dying at the same rate as tenants is unexpected, and suggests that epidemic disease was a major factor in mortality. Hollingsworth's (1975) famous finding that English peers in the late fourteenth and fifteenth centuries did not enjoy longer life expectancies than poorer commoners has frequently been cited against evidence of any connection between living standards and mortality. What we see instead is that mortality of the nobility is reflecting the living standards of the poor, through the connection of epidemic disease.

What precisely these epidemic diseases were is impossible to say: even the identity of the Black Death is disputed.[4] The mortality among nobles suggests some form of influenza, which has been identified as the main killer during the last national famine in England in 1556-58 (Hoskins, 1964). We now consider what role, if any, harvests played in determining mortality.

3 Living Standards and Mortality.

To start we look at mortality among tenants. We suppose the number of fines to inherit land paid on manor i each year has Poisson distribution with parameter θ_i where

$$\theta_i = \alpha_i + \sum_{t=0}^{p} \beta_{it} \ln y_{-t} + \sum_{t=0}^{q} \gamma_{it} \ln \theta_{-t} \tag{1}$$

where y_{-t} is the median grain yield (or real wage) t years ago. Coefficients are immediately interpretable as elasticities.

The first step in answering how mortality was affected by harvest yields is to ask: "Yields of what?" While wheat was the primary commercial grain, spring grains like oats and barley cost less per calorie, grow on worse land, and are more resistant to bad weather, offering subsistence farmers better insurance against starvation in bad years. Account records of what manors fed their servants—outside harvest time when better food was on offer to attract seasonal workers and to fuel intense physical exertion— show that the staple food of the poor before the Black Death was dredge, a mixture of barley and oats (Dyer, 1988). Yields of cheaper spring grains may therefore be most important in explaining deaths.

Regressing inheritances on cereal yields, we found, however, little connection between yields of spring grains and mortality. This probably reflects the fact that many tenants had holdings too small for subsistence, meaning that they had to work to buy grain; and the price of all grains closely tracked wheat yields (Kelly and Ó Gráda, 2008). The strongest relations were between wheat yields and subsequent mortality, but stronger still was the connection with lagged real wages of agricultural labourers from Allen (2007), which performed somewhat better than the corresponding series by Clark (2007*b*).[5]

Figure 5 plots lagged real wages against the number of inheritances on the 20 largest manors, from the first reliable year of data in 1269 to the eve of the Black Death in 1348, leaving out the Great Famine peak in 1317. There are several outlying observations: the under-reporting of 1323 is clear, while the low value in 1318 reflects the normal fall in mortality at the end of a famine: the

[4] Cohn (2002) argues that the lethality and rapid spread of Black Death suggest that it was more likely to have been a haemorrhagic fever, like Ebola, than bubonic plague.

[5] Allen's wage series are for harvest years rather than calender years which Clark uses: for example, Allen's real wage for 1300 (corresponding to Clark's wage for 1301) is based on the harvest in the autumn of that year, and would have held until the harvest of 1301. We move Allen's series one year forward in this paper.

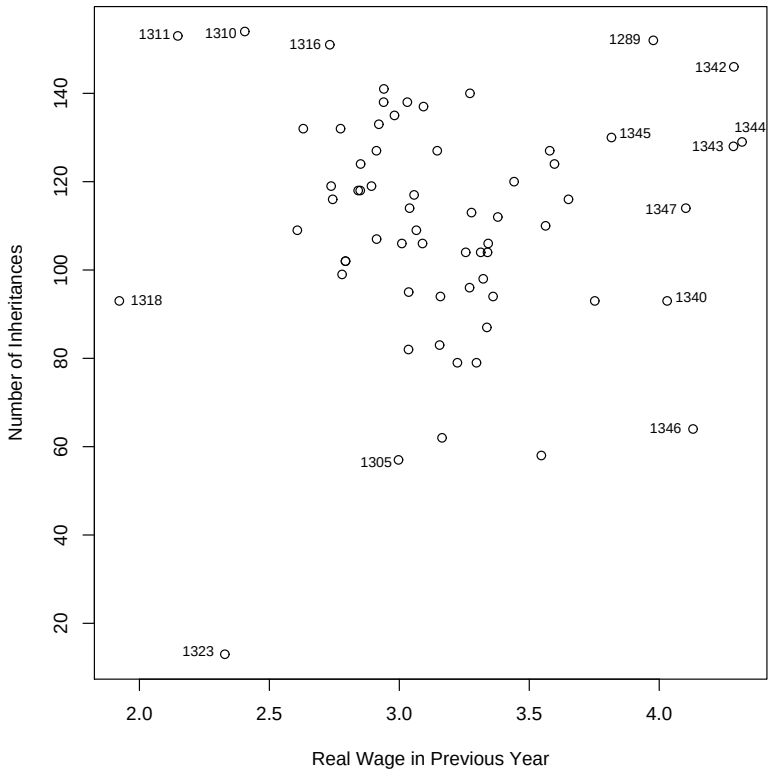

Figure 5: Number of inheritances on the largest 20 Winchester manors versus real wages in the preceding year, 1269–1348. 1317 is excluded.

unhealthy had already been severely culled from the population. There are a number of observations in the top right of the diagram that plainly correspond to periods of pestilence: heavy mortality despite good harvests. 1289 and 1342 have previously been identified by Postan and Titow (1959) as years of presumptive pestilence, but the cluster of unusually high mortality from 1343 to 1347 appears to be the result of mis-measurement in the wage series: if wheat yields, which usually correlate strongly with real wages, are used instead these outliers disappear.

Table 1 reports the results of a regression of number of inheritances on each manor on the real wages and inheritances on the same manor in the two previous years; both for the 20 largest manors and the entire sample. Dummies are added for the years of unusual mortality identified above: 1269, 1317, 1318 and 1342–44. Mortality responds strongly to real wages in the previous year, with an elasticity exceeding one half; although, as an area of fairly low population density (Campbell, 2007) and mild climate, the impact of bad harvests was probably less here than in other parts of England. It can also be seen that increased mortality in one year is followed by slightly

	Wage.l1	Inherit.l1	Inherit.l2	d.1289	d.1317	d.1318	d.1342-44	$\tilde{R}^2$	loglik
20	-0.5859^{**}	0.0437^{**}	0.0331^{**}	0.4263^{**}	0.5579^{**}	-0.4892^{**}	0.3231^{**}	0.4732	-794
	(0.1044)	(0.012)	(0.0119)	(0.0878)	(0.0794)	(0.1165)	(0.0625)		
All	-0.4852^{**}	0.0265^{**}	0.0176^{*}	0.4177^{**}	0.6004^{**}	-0.4142^{**}	0.2975^{**}	0.5945	-1482.7
	(0.0906)	(0.0075)	(0.0072)	(0.0781)	(0.0689)	(0.099)	(0.0531)		

Multilevel Poisson regression of the number of inheritances on lagged inheritances and real wages of agricultural labourers (in logs) by year from 1263 to 1348, with dummies for years of unusual mortality. Observations of lagged inheritances of zero are set to 0.001. There are 927 observations for the 20 largest manors, and 1858 for the entire group of 66. $\tilde{R}^2$ is the squared correlation between fitted and actual values. Intercepts not reported.

Table 1: Effect of real wages and past mortality on inheritances, 1263–1348.

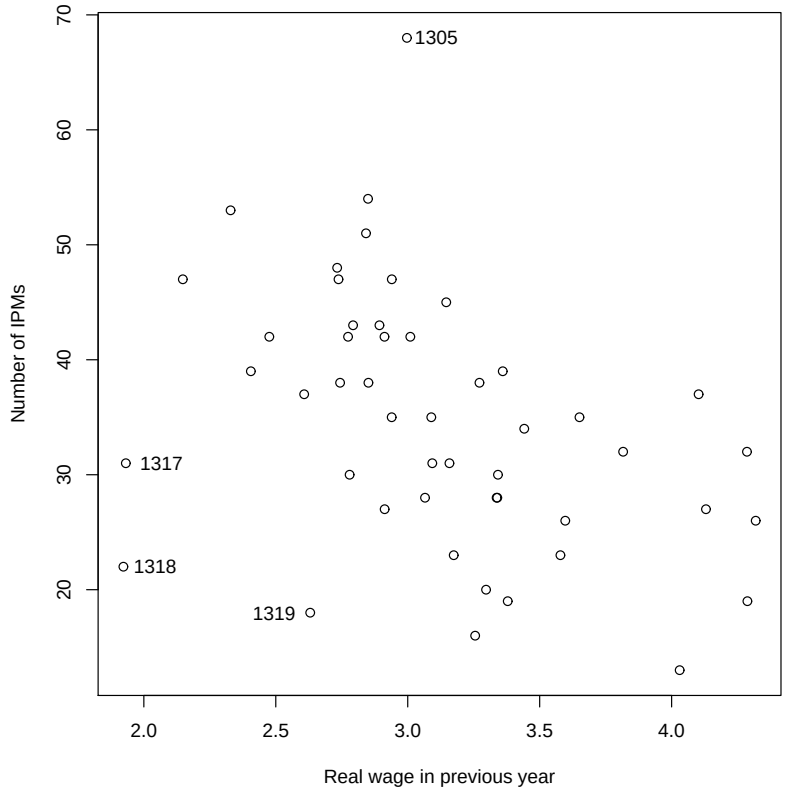

Figure 6: Annual number of Inquisitions Post Mortem versus real wage in the previous year, 1300–1348.

higher mortality in the two following years. This slight positive autocorrelation is in contrast to the strong negative autocorrelation in mortality after the sixteenth century (see Table 4 below).

The size distribution of fines allows us also to see if years of severe epidemic mortality—1317 and 1349— had different social distributions of mortality than ordinary years. After 1303, the

Intercept	Wage.l1	IPMs.l1	Null Dev.	Res. Dev.	$\tilde{R}^2$
4.1567**	−0.9854**	0.1427	109.0	51.1	0.579
(0.589)	(0.2338)	(0.116)			

Poisson regression of annual number of IPMs on log real wage and lagged IPMs. Dummies for 1305, and 1317–19 are not reported. Standard errors in parentheses. * denotes significance at 5 percent, ** at 1 percent. $\tilde{R}^2$ is the squared correlation between the fitted and actual number of IPMs.

Table 2: Regression of IPMs on real wages, 1300-1348.

median fine is 80 pence, identical to the median fines in 1317 and 1349, suggesting that tenants at all levels suffered equally during these crises.

Adding summer and winter temperature as explanatory variables, using the reconstructions of Kelly and Ó Gráda (2008), to test if weather conditions had direct effects on mortality, did not produce effects that were substantial or significant.

Figure 6 shows the relationship between real wages in one year and IPMs the next. The low entries for 1317–1319 suggest considerable under-enumeration in the aftermath of the Great Famine but 1305 is a puzzling outlier that does not correspond to any battle or demographic event. Again, the cluster of observations along the right hand edge of the plot appear to be the result of mis-measured real wages in the 1340s.

Table 2 gives the results of a regression of the annual number of IPMs on current and lagged real wages and IPMs. Again the first plague year of 1349 is excluded to prevent its mortality induced poor harvest generating spurious significance, and the outliers 1305 and 1317–19 are given dummy variables. It can be seen that wealth was no armour against death from epidemic disease that had incubated among hungry peasants: the elasticity of mortality with respect to the real wage of agricultural labourers is minus one. There is no autocorrelation of deaths in this group, again showing their dependence on mortality patterns in wider society. This vulnerability to epidemic illness is further suggested by Nash's (1980) Wiltshire data which shows that nobles died predominantly during the summer months, at the time of greatest hunger before the new harvest.

4 Harvests and Deaths in the Fifteenth Century.

The Black Death of 1348–49 and subsequent recurrences of pestilence reduced population to around 3 million by 1400, and to around 2.75 million by 1450 where it stayed until the early sixteenth century. A consequence of this population collapse was very high real wages, which as Figure 1 on page 2 shows, were not matched again until the late nineteenth century. That population remained static despite high living standards appears due to recurrences of epidemic disease. In this Section we look at the dynamics of mortality in a plague era.

wage.l1	wills.l1	wills.l2	$\tilde{R}^2$	loglik	N	Courts
0.1115	0.5092**	0.0249	0.3363	−954.8	88	2
(0.6372)	(0.0225)	(0.0218)				

Poisson regression of the number of wills on lagged wills and real wage (in logs). Intercepts not reported. $\tilde{R}^2$ is the squared correlation between fitted and actual values, N is the number of observations, and Manor is the number of manors.

Table 3: Effect of real wage and past mortality on wills, 1430–1480.

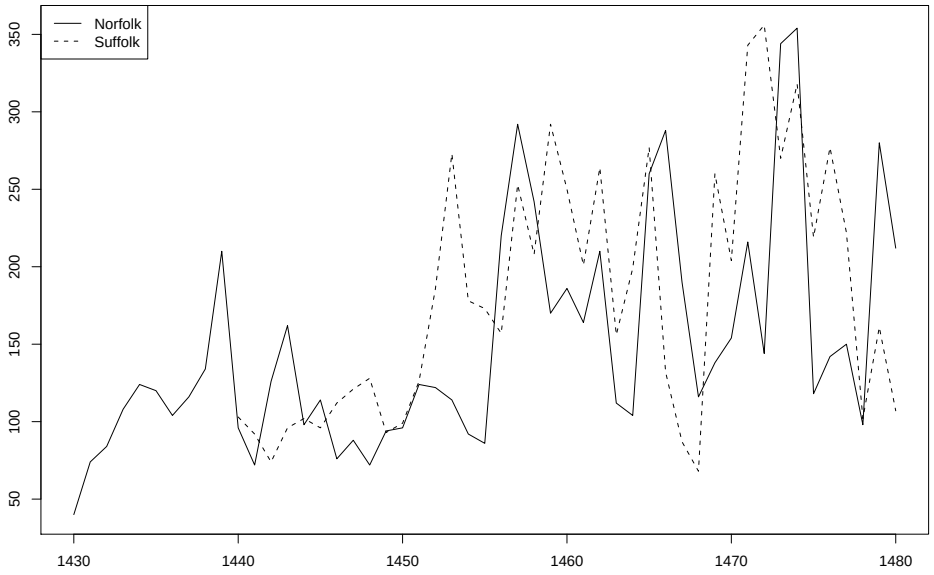

Figure 7: Number of wills processed by courts of the diocese of Norwich, 1430–1480.

Our data come from Gottfried (1978) who examined surviving wills from the diocese of Norwich, then the joint-second largest city in England, from 1430 to 1480 to determine how frequent and severe were epidemics; and what were the demographic characteristics of the deceased. Gottfried found that the main factor in mortality in this time was the high frequency—every five to six years—of epidemics; that marriage rates were usually high but that few people, except children of the wealthy, married before age 25; and that replacement ratios, measured by number of surviving sons of male testators, were unusually low, in the region of 0.7 (Gottfried, 1978, 225–230).

We focus on the two largest and, in Gottfried's (1978, 18–22) estimation, most complete series of wills: those from the Consistory Court of Norwich, which typically processed larger wills, and the subordinate court of the archdeaconry of Suffolk. Annual totals of these series, showing recurrent spikes resulting from epidemics, are presented in Figure 7.

Table 3 gives the results of a Poisson regression of number of wills each year on lagged real wages and the number of wills in the preceding two year. A log-likelihood test indicated that both

	wage.l1	wage.l2	wage.l3	cdr.l1	cdr.l2	cdr.l3	R^2
1542-1625	−0.1711	−0.2797*	−0.3217*	−0.2245*	−0.0726	−0.2367*	0.2223
	(0.1408)	(0.1341)	(0.1433)	(0.1157)	(0.113)	(0.1154)	
1626–1801	−0.0519	−0.2389*	0.0549	−0.2918**	−0.2312**	−0.2256**	0.1716
	(0.103)	(0.1007)	(0.1024)	(0.076)	(0.076)	(0.0717)	

Regression of crude death rates on lagged real wage and crude death rates, intercepts not reported. All variables are first differences of annual logs. * denotes significance at 5 percent, ** at 1 percent.

Table 4: Impact of real wages on death rates, 1542–1801.

the intercept and coefficient of the real wage differed across the two locations. As expected for a period of high living standards and recurrent epidemics, mortality measured by wills is indepent of variations in real wages but responds strongly and positively to mortality in the previous year.

5 Living Standards and Mortality after 1541.

Having seen the strong positive check at work before the Black Death, we now consider how living standards affected death rates after the sixteenth century. Table 4 gives the results of a regression of death rates on lagged deaths rates and real wages, using Allen's South of England agricultural labourer series (again moved forward to correspond to calendar years), from 1542 to 1801. All series are in logs, and are first differenced to remove the impact of long-run factors such as population, technology, urbanization, public health, and social institutions.[6]

To test whether the relationship between living standards and death rates was constant during this period, we applied a Bai and Perron (1998) test for multiple breakpoints. This indicates that the strongest single break in the data occurs in 1625 (the break is not statistically significant at conventional levels, reflecting the fact that the impact of wages is changing from significant to insignificant), and we present regressions for both sub-periods in Table 4. There are two notable contrasts with the medieval death rates: the smaller impact of real wages on deaths; and the negative autocorrelation of mortality. First, the coefficients on real wages, which correspond to elasticities, are a good deal smaller, with a peak cumulative impact of only 0.5 before 1625, and only 0.2 afterwards, and long run elasticities of zero (impulse response functions were calculated by lagging wages by one period, in other words using harvest years rather than calendar years). In addition, these later mortality figures include deaths of children and the indigent (who were at increased risk of death from hunger and epidemics), while the medieval data are restricted to adults owning at least some property.

[6]Non-stationarity did not present problems for differencing. From 1541 to 1800, Phillips-Perron unit root tests produced Z-alpha values of −46 for real wages, and −108 for deaths. The 1 per cent critical value is −20.6.

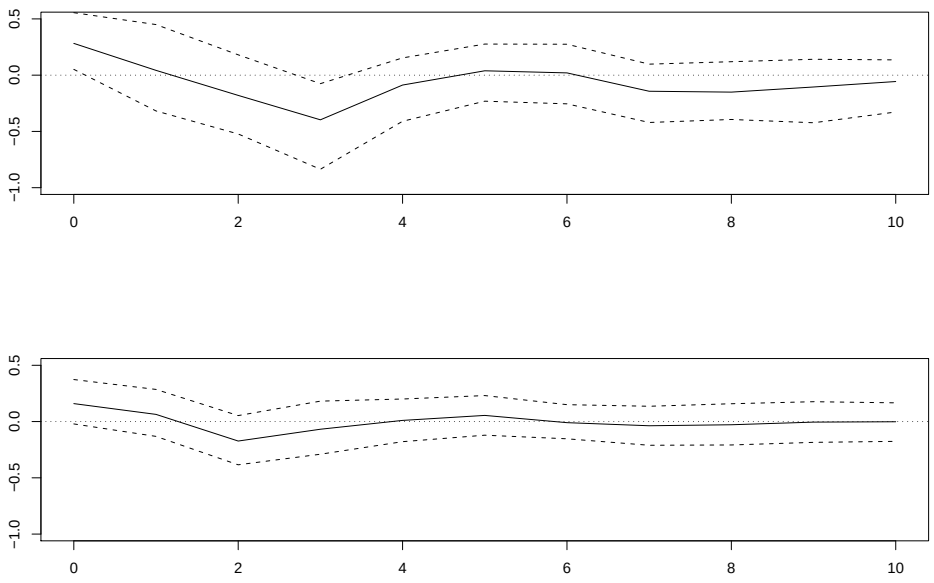

Figure 8: Cumulative impulse response functions with bootstrapped 95 per cent confidence intervals for the impact of log real wages on log death rates, 1542–1625, and 1626–1801.

The second change is in the impact of past deaths on current mortality. The autoregressive coefficients after the sixteenth century are negative. A spike in mortality is followed by a reduction in subsequent deaths so poor harvests are accelerating the mortality of the already ill, rather than killing previously healthy people. This is in contrast to the epidemic driven mortality of the medieval period when an increase in deaths is followed by further increases.

6 What Had Changed?

We have seen that, between the late thirteenth and late sixteenth centuries, the impact of harvests on mortality declined drastically, and the autocorrelation of mortality changed from positive and self-reinforcing, to negative. The positive check moderated further during the early part of the seventeenth century. What stopped bad harvests killing people on a large scale? We consider four possible factors: higher real wages; reduced variance of grain output; increased urbanization; and changing climate. We then go on to consider the possible role of institutions, namely improved public health measures and the Old Poor Law.

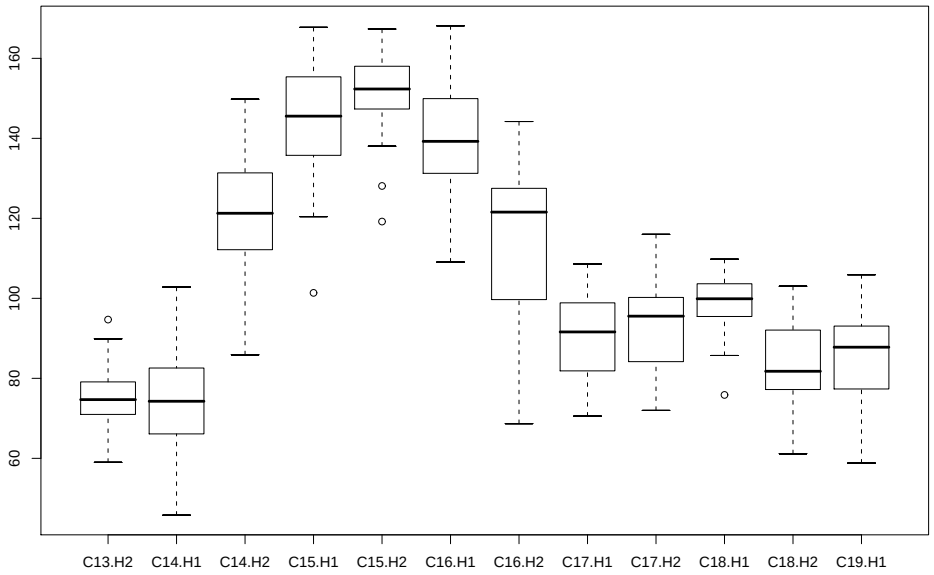

Figure 9: Boxplot of distribution of real wages of agricultural labourers by half century: 1264–1849.

First real wages. Figures 1 and 9 show that real wages of agricultural labourers were higher after the sixteenth century than they were before the Black Death.[7] However, two things suggest that higher incomes alone were not sufficient to eliminate the positive check.

First, as we noted in the Introduction, while average living standards in England were high by contemporary standards, about one fifth of the population in the late seventeenth century lived at the edge of biological subsistence. Secondly, if the disappearance of the positive check in this period were simply due to rising living standards, we would expect that the positive check would be weaker in London than in the rest of England, because wages were higher there: between 1650 and 1750 building labourers in London earned between 1.5 and 2 times as much as in Oxford (Allen, 2007).

Table 5 gives a regression of annual percentage changes in deaths on the percentage change in Allen's series of London real wages for building labourers, from 1648 to 1750 for London, and for the rest of England.[8] Dummies are added for the rise and subsequent fall in London mortality in the Great Plague year of 1665, whose impact was limited to London. It can be seen that outside

[7]The low wages in the late eighteenth century reflected low demand for agricultural labour in the south of England as land was turned over to pasture (Broad, 2000): wages in London and the industrializing north were considerably higher. In addition, Apostolides et al. (2008) point out that national income rose faster than daily wages during the seventeenth century because people were able to work more days each year.

[8]Deaths are based on London Bills of Mortality, which were compiled by government to monitor plague outbreaks: see Galloway (1985). The rest of England figure is obtained by substracting the London figure from the Wrigley and Schofield (1981, Table A3.1) national estimate.

	wage.l1	wage.l2	deaths.l1	deaths.l2	d.1665	d.1666	R^2
London	−0.3076*	−0.1027	−0.3217**	−0.1373**	1.7136**	−1.4649**	0.8569
	(0.1287)	(0.1315)	(0.0645)	(0.0519)	(0.1151)	(0.1629)	
Elsewhere	−0.1465	−0.2751*	−0.154	−0.1918*			0.0989
	(0.1476)	(0.1476)	(0.0984)	(0.0986)			

Regression of deaths in London and the rest of England on lagged real wage and deaths, intercepts not reported. All variables, except the dummies for 1665 and 1666, are first differences of annual logs. * denotes significance at 5 percent, ** at 1 percent.

Table 5: Impact of real wages on annual deaths in London and the rest of England, 1648–1750.

London, falling real wages cause only a temporary acceleration of mortality, as shown in the lower panel of Figure 10.

By contrast, a bad harvest one autumn is followed by a marked rise in London mortality the following year, with a long run multiplier of −0.3: see Figure 10. In fact the wage coefficients for London are pulled downwards by 4 outliers (1650, 1652, 1668, and 1744); and if the London regression is re-estimated using a robust procedure with Huber weights, the elasticities of the wage terms rise to −0.38 and −0.26, significant at 1 and 5 per cent respectively, although the long run multiplier is little changed at −0.25.[9] The instantaneous effect of harvests on mortality reflects a rise in epidemic mortality associated with an influx of young adults into the city (Galloway, 1985), and is in contrast to the medieval data where harvests affect mortality with a lag of a year, presumably because as owners of some property, the medieval tenants were spared the immediate impact of dearth.

That rising living standards were not sufficient of themselves to eliminate the positive check is not to deny that they did play a large role. Rising average income did reduce the risk of starvation, and it was only because England was a relatively prosperous place that it was able to afford a generous system of public charity.

Next we consider the possibility that reduced mortality was the result of a better functioning grain market. While Kelly and Ó Gráda (2008) find that grain supply appears to become more responsive to price in the mid-sixteenth century, and that the variability of grain prices does fall after 1600, the variance is still substantial. In half the years in the seventeenth and eighteenth centuries wheat price changed by over 10 per cent, and in one fifth by over 20 per cent.

The next possible factor in reduced mortality is increased urbanization and market activity. However, probably the same fraction of the population, around 6 per cent, lived in towns of over 10,000 in 1300 as in 1600 (Campbell, 2000, 405). Moreover, greater integration into markets tended to increase vulnerability to poor harvests. As Walter (1989) shows, subsistence agriculture provided considerable insulation against steep rises in food prices, which was lost when regions

[9] Using a robust procedure did not materially change the coefficients for the rest of England.

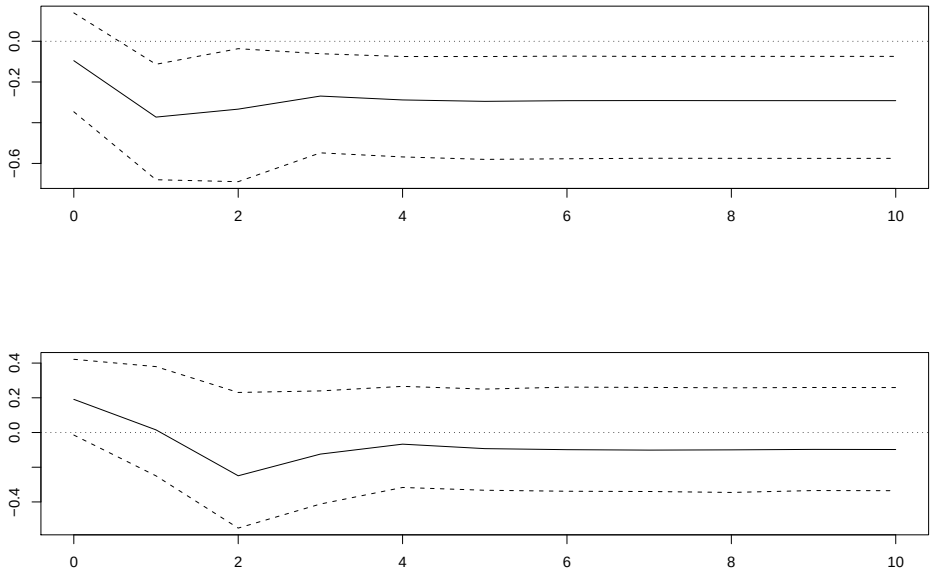

Figure 10: Cumulative impulse response functions with bootstrapped 95 per cent confidence intervals for the impact of log real wages on log death rates for London (top panel) and the rest of England, 1648–1750.

began to specialize in producing one good and import grain, so that the worst mortality crises of the early seventeenth century tended to occur in such proto-industrializing areas.

Finally, lowered mortality might be the consequence of climatic change. However, using their ability to predict medieval grain yields to choose among climatic reconstructions, Kelly and Ó Gráda (2008) find that annual temperature and rainfall are effectively independently and identically distributed between 1300 and 1800.

6.1 The Old Poor Law.

Given that rising living standards, reduced harvest volatility, increased urbanization, and better climate have limited power to explain the weakening positive check between the fourteenth and eighteenth centuries, we consider the possible impact of a central institution of English society before the industrial revolution: the Poor Law.

As we argued in the Introduction, before twentieth century advances in public health, starvation-induced mortality was not an individual fate. Instead, after bad harvests, the poor migrated in search of work or charity, spreading disease and social disorder ranging from petty crime to armed rebellion.[10] Apart from the dictates of religion (whose power at this time should not be

[10]For the eighteenth century, Galloway (1985) found that deaths of young adults in London rose in the aftermath of poor harvests, reflecting an influx of the unemployed from the surrounding areas. Lawson (1986) shows, for the late sixteenth and early seventeenth centuries, that prosecutions for property crime rose after bad harvests. During

underestimated) and paternalistic ideals, the ruling class had strong practical incentives to mitigate the impact of harvest failures on the poor.

In medieval times the main sources of charity were monasteries. While the amounts disbursed appears to have been quite large (Rushton and Sigle-Rushton 2001, Slack 1989, 13), they were given to a fairly fixed group of permanent dependents. Large religious institutions typically devoted the income or produce from one manor to charitable purposes which meant that, after poor harvests, the amounts available for distribution fell as demand rose.

Historians see the beginning of a concern with public charity in the mid-sixteenth century, as population pressure drove down real wages (compare Figure 1). Central government response took two main practical forms: punishing vagrants; and regulating grain markets in years of poor harvests through so-called Books of Orders. These prohibited exports, restricted grain movements, and allowed magistrates to inspect grain stores (Leonard 1900, 61–66, Slack 1989, 113–137, Fogel 1992). However, at this time local charity was probably more important: both private where wealthy individuals endowed institutions; and municipal where local governments distributed subsidised grain or gave money directly to poor families (Walter, 1989).

What made England unique during the seventeenth and eighteenth centuries was its comprehensive, national system of outdoor poor relief funded by local property taxes. While sixteenth century parliaments routinely passed laws to enact such a system, culminating in the Vagrancy and Poor Relief Statutes of 1598, the government only began actively to force parishes to implement poor relief in the 1620s. During this time, the Personal Rule of Charles I, the state developed a short and effective chain of administration from the King's Privy Council, through local grandees acting as county magistrates, to local farmers acting as village constables. This led most of the more populous parishes implement a system of poor rates to subsidise local families in need of assistance. Most charity went to those in permanent need: the elderly, the disabled, and widowed or deserted mothers of small children; but with some aid going to families in temporary need because of illness, unemployment, or high food prices. Another facet of increasing state paternalism was aggressive measures against epidemic disease, to which Slack (1981) attributes the disappearance of plague in the 1660s.[11]

This system was already sufficiently well entrenched by the 1640s to continue operating through the Civil Wars. By the end of the seventeenth century, Poor Law expenditure was about 1 per cent of national income, sufficient to provide complete subsistence for 5 per cent of the population; and increased to around 2 per cent of national income by the end of the eighteenth century (Slack, 1989). For comparison, O'Brien (1988) estimates that central government taxation equalled around

the sixteenth century, disorder ranging from serious riots to armed rebellion occurred after harvest failures (Leonard, 1900, xx).

[11]The timing of the disappearance of plague listed by Slack (1981) give an index of governmental effectiveness: England in 1660s, France in the 1730s, Moscow in the 1770s, and the Balkans in 1840s.

Year	Price Rise	Mortality	Year	Price Rise	Mortality
1549	0.49	27.9	1647	0.34	24.9
1550	0.45	27.9	1656	0.43	38
1555	0.32	42.5	1680	0.34	38.9
1556	0.41	53.9	1692	0.36	30.2
1574	0.34	22.5	1709	0.55	28.5
1581	0.37	22.1	1728	0.3	44.7
1586	0.33	28.6	1740	0.32	36.7
1594	0.37	24.1	1757	0.35	27.4
1608	0.36	28.9	1800	0.49	28.1
1622	0.31	30.3			

Years with rises in wheat prices of at least 30 per cent, and the maximum crude death rate in the following two years.

Table 6: Mortality after bad harvests, 1541–1800.

3.5 per cent of national income in the 1670s and 1680s, rising to 9 per cent in the 1690s, and 12 per cent by 1790.

Was this expenditure effective? Slack (1989, 207) concludes that after 1620 the system worked to minimize outright starvation. In other words it probably worked to keep the numbers of destitute people below a critical threshold needed for epidemic disease to gain a hold in the general population, something that was aided by the prohibitions against vagrancy, and the insistence that aid would only be offered in one's home parish. It is notable that the reduction of the positive check around the late 1620s, shown in the impulse-response functions of living standards on deaths rates in Table 4 and Figure 8; coincides with the emergence of a national system of poor relief at this time.

The effectiveness and limitations of Poor Relief are shown in Figure 6 which shows peak mortality in the two years following a rise in wheat prices of at least thirty per cent. It can be seen that, after the 1550s, there is an almost complete elimination of catastrophic mortality, with no rises in mortality after 1709 and 1800 despite wheat prices increasing by half. However, it is equally apparent that the system was capable of being overwhelmed when poor harvests were accompanied by epidemic illness which left large fractions of the population too ill to work, of the sort that occurred in 1740–42 and, especially, 1728–30.

7 Conclusions.

Where numerous earlier studies have noted that bad harvests after the sixteenth century did not kill many English people, this paper asked "Why?". Constructing new series of mortality among tenants and nobility in the century before the Black Death, we found that bad harvests in this period were deadly at all levels of society. Similarly, after the sixteenth century we found that bad harvests caused large and permanent rises in London mortality, despite wages there that were 1.5 to 2 times those elsewhere. This led us to conclude that the disappearance of the positive check in

England was not simply a consequence of rising living standards, but may also have been a result of the elaborate system of parish funded poor relief established in the early seventeenth century.

Appendix: Data Sources and Estimation

- Crop yield data are from Campbell (2007): http://www.cropyields.ac.uk.
- Marriage and entry fines on the Winchester manors are from M. Page, "Peasant Land Market in Southern England, 1260-1350" available from http://ahds.ac.uk/catalogue/collection.htm?uri=hist-4086-1.
- Annual numbers of IPMs from 1300 to 1349 from Campbell (2005) were provided by the author.
- Annual numbers of wills in the Diocese of Norwich from 1430 to 1480 were calculated from Graph 4.1.1 in Gottfried (1978).
- Wage and price data are taken from Robert Allen's database of Prices and Wages in London and Southern England, 1259–1914 (http://www.nuff.ox.ac.uk/users/allen/studer/london.xls).
- Vital rates per 1,000 population from 1541 to 1870 are from Wrigley and Schofield (1981) Table A3.1.
- London deaths from the Bills of Mortality are taken from Marshall (1832).
- Estimation was carried out in *R*. Panel regressions were estimated using the `lme4` module, vector autoregressions using the `vars` module, coefficient stability using the `strucchange` module, and sensitivity to outliers using the `forward` module.

References

Allen, Robert C. 2007. *Prices and Wages in London and Southern England, 1259–1914*. WWW Document. URL:http://www.nuff.ox.ac.uk/users/allen/studer/london.xls. 9, 16

Allen, Robert C. 2008. "A Review of Gregory Clark's 'A Farewell to Alms: A Brief Economic History of the World'." *Journal of Economic Literature* 46:946–973. 1

Apostolides, Alexander, Stephen Broadberry, Bruce Campbell, Mark Overton and Bas van Leeuwen. 2008. English Gross Domestic Product, 1300–1700: Some Preliminary Estimates. Working paper University of Warwick. 16

Bai, Jushan and Pierre Perron. 1998. "Estimating and Testing Linear Models With Multiple Structural Changes." *Econometrica* 66:47–78. 14

Boyer, George R. 1989. "Malthus Was Right after All: Poor Relief and Birth Rates in Southeastern England." *Journal of Political Economy* 97:93–114. 4

Broad, John. 2000. "Housing the Rural Poor in Southern England, 1650–1850." *Agricultural History Review* 48:151–170. 16

Campbell, Brucd M. S. 2000. *English Seigniorial Agriculture 1250–1450*. Cambridge: Cambridge University Press. 17

Campbell, Bruce M. S. 2005. "The Agrarian Problem in the Early Fourteenth Century." *Past and Present* 188:3–70. 3, 6, 21

Campbell, Bruce M. S. 2007. *Three Centuries of English Crops Yields, 1211–1491*. WWW Document. URL http://www.cropyields.ac.uk. 10, 21

Chandra, Ranjit Kumar. 1996. "Nutrition, Immunity and Infection: From Basic Knowledge of Dietary Manipulation of Immune Responses to Practical Application of Ameliorating Suffering and Improving Survival." *Proceedings of the National Academy of Sciences of the United States of America* 93:14304–14307. 3

Clark, Gregory. 2007*a*. *A Farewell to Alms*. Princeton: Princeton University Press. 2

Clark, Gregory. 2007*b*. "The Long March of History: Farm Wages, Population, and Economic Growth, England 1209-1869." *Economic History Review* 60(97–135). 9

Cohn, Samuel K. 2002. "The Black Death: End of a Paradigm." *American Historical Review* 107:703–738. 9

Dyer, Christopher. 1988. "Changes in Diet in the Late Middle Ages: The Case of Harvest Workers." *Agricultural History Review* 36:21–38. 9

Ecclestone, Martin. 1999. "Mortality of Rural Landless Men before the Black Death : the Glastonbury Head-tax Lists." *Local Population Studies* 63:6–29. 4

Fogel, Robert W. 1992. Second Thoughts on the European Escape from Hunger: Famines, Chronic Malnutrition, and Mortality Rates. In *Nutrition and Poverty*, ed. S. R. Osmani. Oxford: Clarendon Press. 4, 19

Galloway, P. R. 1985. "Annual Variations in Deaths by Age, Deaths by Cause, Prices and Weather in London, 1670 to 1830." *Population Studies* 39:487–505. 16, 17, 18

Gottfried, Robert S. 1978. *Epidemic Disease in Fifteenth Century England: The Medical Response and Demographic Consequences.* Rutgers: Rutgers University Press. 3, 4, 13, 21

Hatcher, John. 1986. "Mortality in the Fifteenth Century: Some New Evidence." *Economic History Review* 2nd series 39:19–38. 4

Hatcher, John, A.J. Piper and David Stone. 2006. "Monastic mortality: Durham Priory, 1395–1529." *Economic History Review* 59:667–687. 4

Hindle, Steve. 2004. *On the Parish?: The Micro-Politics of Poor Relief in Rural England c. 1550-1750.* Oxford: Oxford University Press. 4

Hollingsworth, T. H. 1975. "A Note on the Mediaeval Longevity of the Secular Peerage 1350-1500." *Population Studies* 29:155–159. 8

Hoskins, W. G. 1964. "Harvest Fluctuations and English Economic History." *Agricultural History Review* 12:27–47. 9

Kelly, Morgan and Cormac Ó Gráda. 2008. Weather, Yields, and Living Standards in England before the Industrial Revolution. Working paper University College Dublin. 9, 12, 17, 18

Kershaw, Ian. 1973. "The Great Famine and Agrarian Crisis in England 1315–1322." *Past and Present* (59):3–50. 5

Laslett, Peter. 1965. *The World We Have Lost.* London: Methuen. 1

Lawson, Peter. 1986. "Property Crime and Hard Times in England, 1559–1624." *Law and History Review* 4:95–127. 18

Lee, Ronald D. 1981. *Short Term Variation: Vital Rates, Prices, and Weather.* London: Edward Arnold. 4

Lee, Ronald and Michael Anderson. 2002. "Malthus in State Space: Macro Economic-Demographic Relations in English History, 1540–1870." *Journal of Population Economics* 15:195–220. 4

Leonard, E. M. 1900. *The Early History of English Poor Relief.* Cambridge: Cambridge University Press. 3, 4, 19

Lindert, Peter H. 2006. "Poor relief before the Welfare State: Britain versus the Continent, 1780–1880." *European Review of Economic History* 2:101–140. 4

Marshall, John. 1832. *Mortality of the Metropolis.* London: . 21

Mokyr, Joel and Cormac Ó Gráda. 2002. "What Do People Die of during Famines? The Great Irish Famine in Comparative Perspective." *European Review of Economic History* 6:339–364. 2

Nash, A. E. 1980. "The Mortality Pattern of the Wiltshire Lords of the Manor, I242-I377." *Southern History* 2:31–43. 7, 12

Nightingale, Pamela. 2005. "Some New Evidence of Crises and Trends of Mortality in Late Medieval England." *Past and Present* (187):33–68. 4

Ó Gráda, Cormac. 2007. "Making Famine History." *Journal of Economic Literature* 45:5–38. 2

O'Brien, Patrick. 1988. "The Political Economy of British Taxation, 1660–1815." *Economic History Review* second series 61:1–32. 19

Page, Mark. 2003. The Peasant Land Market on the Estate of the Bishopric of Winchester before the Black Death. In *The Winchester Pipe Rolls and Medieval English Society*, ed. Richard Britnell. Woodbridge: Boydell. 3, 5

Post, John D. 1976. "Famine, Mortality, and Epidemic Disease in the Process of Modernization." *Economic History Review* New Series 29:14–37. 4

Postan, Michael and J. Z. Titow. 1959. "Heriots and Prices on Winchester Manors." *Economic History Review* 11:392–411. 4, 5, 10

Razi, Zvi. 1980. *Life, Marriage and Death in a Medieval Parish: Economy, Society and Demography in Halesowen 1270–1400*. Cambridge: Cambridge University Press. 4

Rosenthal, Joel T. 1973. "Mediaeval Longevity: and The Secular Peerage, 1350-1500." *Population Studies* 27:287–293. 7

Rushton, Neil S. and Wendy Sigle-Rushton. 2001. "Monastic Poor Relief in Sixteenth-Century England." *Journal of Interdisciplinary History* 32:193–216. 19

Sen, Amartya. 1981. *Poverty and Famines: An Essay on Entitlement and Deprivation*. Oxford: Clarendon Press. 3

Slack, Paul. 1981. "The Disappearance of Plague: An Alternative View." *Economic History Review* 34:469–476. 19

Slack, Paul. 1989. *Poverty and Policy in Tudor and Stuart England*. London: Longman. 4, 19, 20

Smith, Richard M. 2008. Welfare Citizenship, Rural Poverty and Epidemiological Patterning: Extending the Solar Case for the Relative Efficacy of Poor Relief Provisions under the English Old Poor Law. Technical report Department of Geography, University of Cambridge. 4

Solar, Peter M. 1995. "Poor Relief and English Economic Development before the Industrial Revolution." *Economic History Review* 1:1–22. 4