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

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Abstract

Existing studies, starting from the sixteenth century, find a puzzlingly weak connection between living standards and mortality. This paper uses records of property transfers to extend estimates of mortality back to the mid-thirteenth century, and finds by contrast that deaths, 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 from the sixteenth century, and its disappearance in the early-seventeenth century coincide with the evolution of a national system of poor relief and increasingly effective public health measures against epidemic disease. Our analysis suggests that existing models of pre-industrial societies as passive victims of ineluctable Malthusian laws need to be supplemented by an appreciation of how social institutions could deliberately alter the link from living standards to population growth.

[*]Very preliminary.

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. The disappearance of the positive check strikes us as extremely puzzling: in a society where a large fraction of the population lived at the edge of biological subsistence, it is hard to see how a fall in living standards would not be followed by a marked rise in mortality.

To understand the link between living standards and mortality, this paper begins by extending estimates of mortality back to the middle ages. Where previous studies have looked exclusively 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; and we look at how these 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, falls in real wages caused by poor harvests were deadly at all levels of society from poor tenants to the high nobility. Poor harvests cause mortality to rise markedly, while deaths show positive autocorrelation: increased mortality one year leads to a rise in mortality the following year, in contrast to the time after the mid-sixteenth century when subsequent mortality falls sharply. In the high wage period of the fifteenth century (see Figure 1 on page 3) we find no connection between mortality and harvest yields but strong positive autocorrelation in death rates associated with the frequent epidemics of the time.

How are we to explain why poor harvests were so lethal in the late thirteenth century but had a limited impact in the later centuries, despite standards of living in both periods that were low and volatile (see Figure 1 on
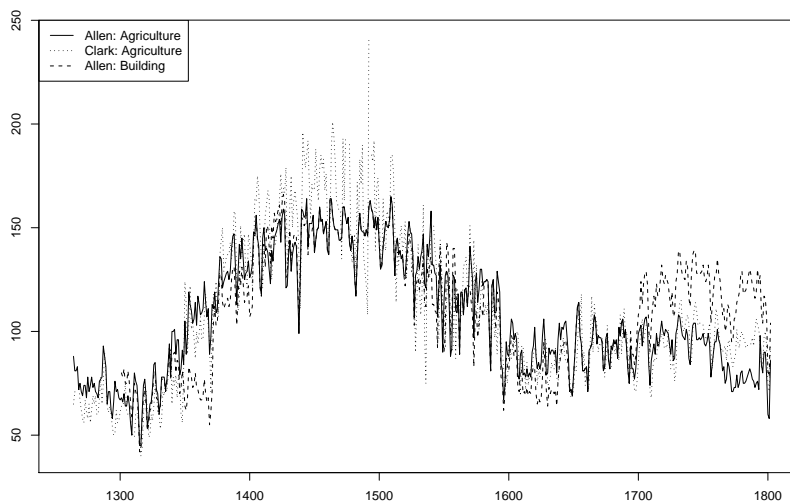
Figure 1: Real wage of labourers in the south of England, 1264–1802.

)? 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 fall in living standards causes birth rates to fall and death rates to rise; but there is little discussion of exactly what it is that causes deaths to rise. The assumption appears to be 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 (O Grada, 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, worse 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 (other than Holland) sufficiently well organized to act decisively was England. Historians divide English efforts at poor relief into two broad stages: a reliance on interventions in grain markets from the late sixteenth century, supplemented by municipal relief in larger cities and extensive private charity; being replaced by a national system of parish poor rates in the 1620s that endured for two hundred years (Walter 1989, Leonard 1900). Another facet of increasing state paternalism was aggressive measures against epidemic disease, to which Slack attributes the disappearance of plague in the 1660s.

Against the conventional wisdom of pre-industrial economies as passive victims of iron Malthusian processes, it would appear instead that societies had considerable incentive, and sometimes 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 quaranting of infected families was, usually, sufficient to prevent periods of dearth transforming into national epidemics.

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 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.

After 1541 when the systematic population reconstructions of Wrigley and Schofield (1981) become available, we use a vector autoregression to examine the relationship between living standards and mortality rates. In keeping with earlier studies, we find a strong negative autocorrelation in death rates, and that the impact of real wages is not large, and weakens considerably after the 1620s.

This paper draws together three literatures that have existed almost independently of each other: living standards and population growth after the sixteenth century; medieval mortality; and 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, but no study, from Wrigley and Schofield (1981, 412–417) and Lee (1981), and continuing to Lee and Anderson (2002) who survey the intervening literature, finds evidence of a positive check after the early seventeenth century. A similarly small impact of real wages on mortality is found by Weir (1984) for France after the seventeenth century; and by Galloway (1988) for other European countries during the eighteenth and nineteenth centuries. 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 the Poor Law or increasingly aggressive enforcement of public health measures 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 all these authors restrict themselves to describing patterns of mortality and do not focus on its possible connection with living standards, or its autocorrelation which are our central concerns here.

Classic historical discussions of the English Poor Law are Leonard (1900) and Slack (1989) and, although the concern of most recent historical study, surveyed by Hindle (2004), is with the micro-politics of its operation; there is increasing interest in its effectiveness as shown in the useful survey of Smith (2008). Most economic historians focus on the late eighteenth century and

after: for instance Boyer (1989), 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 study closest to ours is Malthus's *On the Causes of the Present High Price of Provisions* from 1800, discussed by Wrigley (1999), which asked why poor harvests caused the extreme suffering and mortality that he had witnessed in Scandinavia but had a limited impact in England, and concludes that the reason lay in the effectiveness of the poor laws.

The rest of the paper is as follows. Section 2 looks at the relationship between harvest yields and tenant mortality in the eighty years before the Black Death, while Section 3 shows that the nobility suffered the same increased mortality after poor harvests that the rest of society did. Section 4 looks at fifteenth century mortality and again finds mortality rising in the wake of poor oat harvests. To contrast our medieval results with the intensively studied period after the mid-sixteenth century, Section 5 looks at the relationship between real wages and vital rates from the sixteenth century until the first world war.

2   Yields and deaths on Medieval manors.

On medieval estates, unfree tenants had to pay a fine at the manorial court to transfer tenancy of land, or to allow their daughters to marry, and the records of these payments survive in large numbers. A typical account roll entry, for the manor of Downton in 1325, is "And for 30 shillings from Isabella, who was Roger's le Muleward wife, to retain one messuage and half-virgate of land 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 between 1263 and the arrival of the Black Death 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
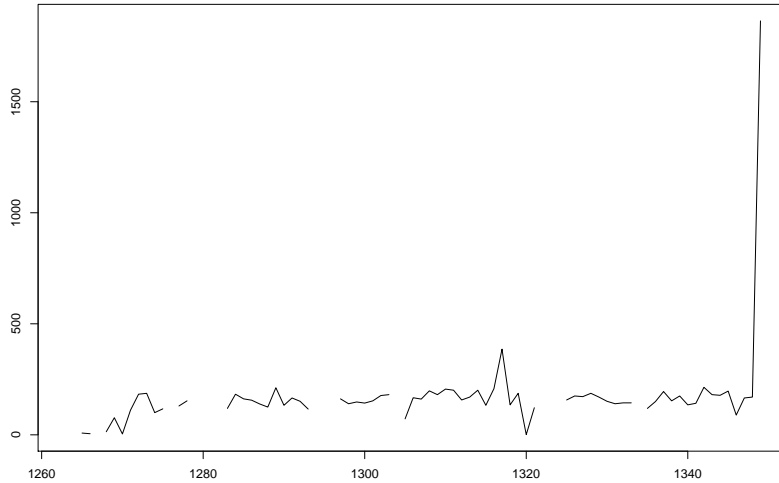
Figure 2: Number of inheritances on the Winchester manors, 1263–1349.

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.

We have records of 12,378 inheritances on 77 manors whose annual totals are plotted in Figure 2. Gaps correspond to 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 (Jordan, 1996).

We can gauge the social level of the people who died from the size of the entry fine their heirs paid. To be a middling farmer required about a half-virgate (roughly 20 acres usually) of land, which commanded in the early fourteenth century an entry fine of at least 30 to 40 shillings, and often

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considerably more. This corresponds to the largest 10 to 15 per cent of fines in our sample, the median fine in our post-1302 sample being 7 and a half shillings. Typical estimates for early the fourteenth century are that about half of all tenants owned less than a quarter virgate, the bare minimum for subsistence (Titow, 1969, 78–81). In other words, then, most of the tenants in our sample are smallholders with too little land for support themselves, requiring them to work as labourers for wealthier farmers.

Manors varied considerably in size and continuity of records. For the period before 1349, the 10 largest manors accounted for 50 per cent of deaths, and the largest 20 for 70 per cent, and these large manors have almost continuous records. By contrast, records for the smallest manors are extremely fragmentary. There are three problematic periods of data. While most large manors in most years always report some deaths, before 1269 most large manors report no deaths: there is clearly severe under-registration. The same occurs in 1323, a year in the middle of a 4 year break in continuous data when many larger manors do not furnish returns; and to a lesser extent in 1305.

We suppose the number of fines for 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 and were 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, both to attract seasonal workers and to fuel intense physical exertion— show that the staple food of the poor was dredge, a mixture of barley and oats (Dyer, 1988). Yields of these grains may therefore be most important in explaining deaths.
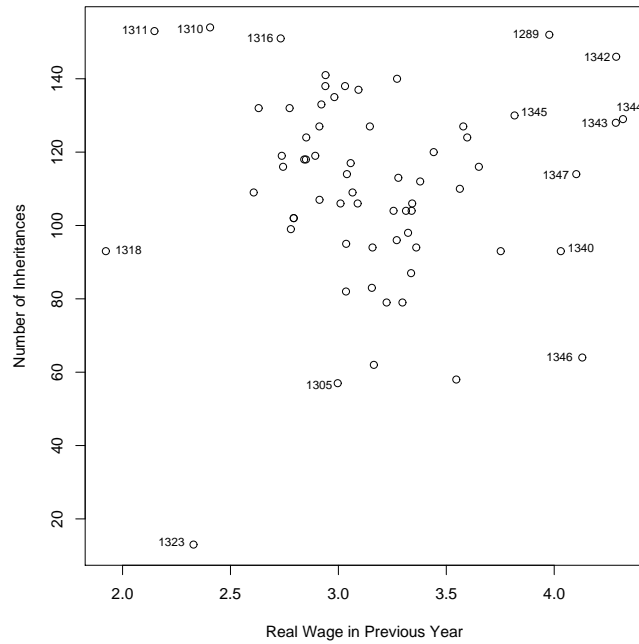
Figure 3: Number of inheritances on the largest 20 Winchester manors versus real wages in the preceding year, 1269–1348. 1317 is excluded.

Running regressions of inheritances on cereal yields, we found, to our surprise, no connection between yields of spring grains and mortality. 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 (2001), which performed somewhat better than the corresponding series by Clark.

Figure 3 plots 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 fall in mortality at the end of the Famine: the unhealthy had 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 had previously been identified

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	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.

by Postan as a year of presumptive pestilence, but the cluster of unusually high mortality from 1342 to 1347 has not previously been remarked on. It suggests that the population just before the Black Death had just emerged from a period of severe epidemic.

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 years of unusual mortality identified above: 1269, 1317,1318 and 1342–44. It can be seen that mortality responds strongly to real wages in the previous year, with an elasticity exceeding one half; while years of increased mortality are followed by slightly higher mortality in the two following years.

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 median fine is 80d, 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 Grada (2008), to test if weather conditions had direct effects on mortality, did not produce effects that were substantial or significant.
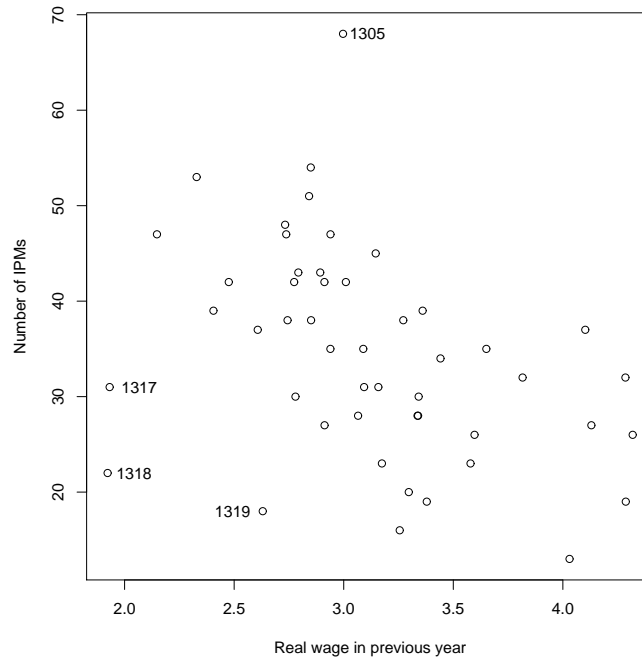
Figure 4: Annual number of Inquisitions Post Mortem versus real wage in the previous year, 1300–1348.

3   Were the very rich different?

Did the lethal impact of bad harvests stop with tenants, or did they also kill at higher levels of society? To answer this we look at the deaths of 1,819 nobles from 1300 to 1349 as measured by Inquisitions Post Mortem.

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, usually by neighbouring nobles. The records of all surviving Inquisitions from 1300 to 1349 were used by Campbell (2005) to assess the income of the English nobility, and we use his numbers here as a proxy for annual deaths among the nobility.[1] This proxy is clearly imperfect: reversion of land to the

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[1]Nash (1980) reports the number of IPMs for Wiltshire from 1242–1377, but the annual numbers are small (usually around 4 or 5) and they are effectively uncorrelated with the numbers here. They illustrate, moreover, the difficulties of under-recording in IPM data: there are far more IPMs associated with the recurrence of epidemic in 1361 than for the

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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.

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.[2] We would expect during periods of weak central authority, such as the reign of Edward II (1302–1327), that numbers of IPMs may underestimate deaths of nobles without adult heirs.

Figure 4 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. 1305 is a puzzling outlier that does not correspond to any battle or demographic event. The six entries along the right edge of the diagram are, in increasing order of mortality, are 1340, 1342, 1344, 1346, 1343, and 1347; again supporting the view of the period preceding the Black Death showing somewhat higher mortality than living standards would warrant.

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 poor harvest generating spurious significance, and the outliers 1305 and 1317–19 are given dummy variables. It can be seen wealth was no barrier to death from epidemic disease that had incubated among hungry peasants: the elasticity of mortality with respect to the real

first, and more deadly outbreak, in 1348–49; while the Great Famine period of 1316–17 is imperceptible.

[2]Nobles were also at risk of death in battle, but at this time the risk was low: 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 4.
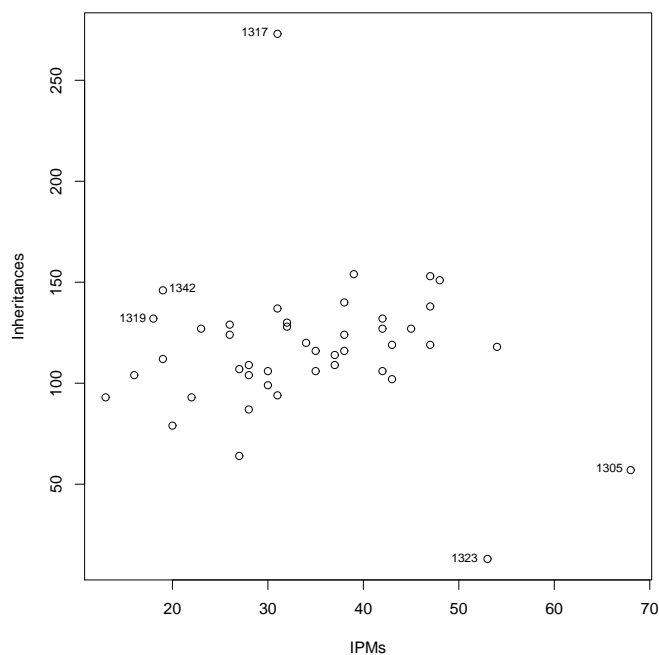
Figure 5: Annual number of Inquisitions Post Mortem versus number of inheritances on the 20 largest Winchester manors, 1300–1348.

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 deaths of nobles occurred predominantly during the summer months, at the time of greatest hunger before the new harvest.

The similarity of the mortality between nobles and the poorest commoners is shown in Figure 5. It suggests under-enumeration of nobles' mortality in 1319, 1342, and especially 1317; with tenants being under-counted in 1323, and also 1305. 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.

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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.

4 Harvests and Deaths in the Fifteenth Century.

The Black Death of 1348–49 and subsequent recurrences of pestilence[3] reduced population to around 3 million by 1400, with further falls 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 3 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.[4] In this Section we look at the dynamics of mortality in a plague era.

Our data come from Gottfried (1978) who examined surviving wills from the large 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).

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[3]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.

[4]Bailey (1996) reviews evidence for a decline in the marriage rate during this period and finds it to be unconvincing.
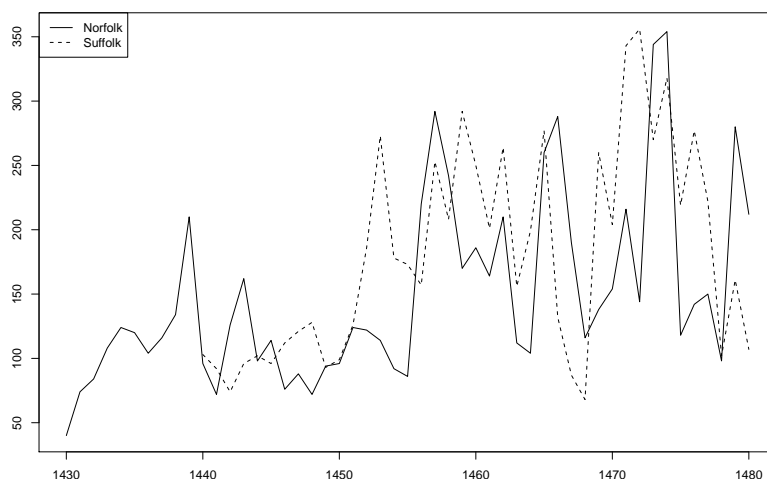
Figure 6: Number of wills processed by courts of the diocese of Norwich, 1430–1480.

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 6.

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 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 and de-stabilizing positive check at work in medieval times, 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 agricul-

	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.

tural labourer series, from 1542 to 1801. All series are in logs, and are first differenced to remove the impact of long-run changes such as population, technology, urbanization, public health, and social institutions.[5]

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, 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. 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.

The second change 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. This is in contrast to the medieval period when an increase in deaths is followed by further increases.

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[5]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.
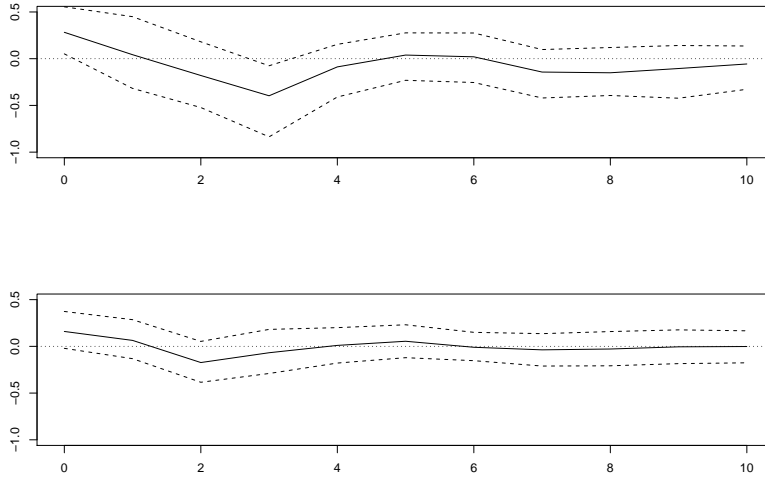
Figure 7: Cumulative impulse response functions for the impact of log real wages on log death rates, 1542–1625, and 1626–1801.

Comparing the pre- and post-1625 regressions we see that the impact of real wages on mortality becomes smaller and largely insignificant after 1625 (it is this slide into insignificance rather than to markedly different significant values that prevents structural break tests from finding a significant break in the data); while the negative autocorrelation of death rates becomes stronger. The diminishing impact of real wages on mortality is shown in the cumulative-impulse response functions, with bootstrapped 95 per cent confidence intervals, for the two periods in Figure 7.

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
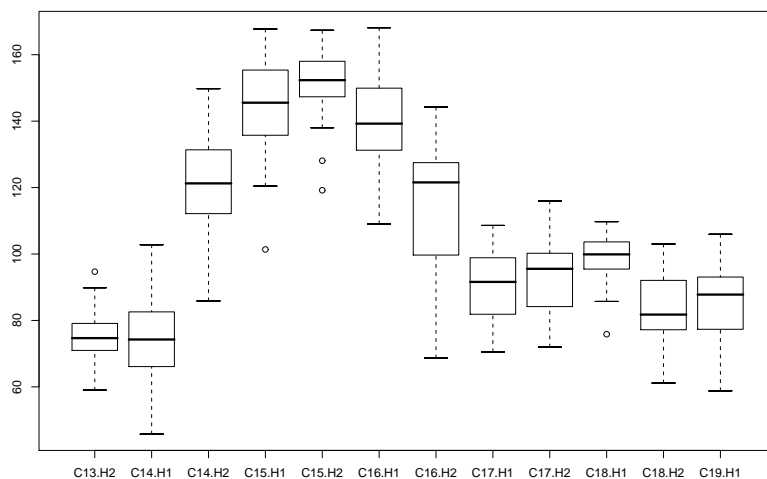
Figure 8: Boxplot of distribution of real wages by half century: 1264–1849.

to consider the possible role of institutions, namely improved public health measures and the Old Poor Law.

First real wages. Figures 1 and 8 show that real wages were similarly low in the early fourteenth and late eighteenth centuries. While real wages were higher in the seventeenth and early eigheenth centuries, as we noted in the introduction, substantial fractions of the population still lived at the edge of subsistence.

Next we consider the possibility that reduced mortality was the result of a better functioning grain market. While Kelly and Ó Grada (2008) find that grain supply appears to become more responsive to price in the mid-sixteenth century and 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 paradoxically 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 began to specialize in producing one good and import grain, and the worst mortality crises of the early seventeenth century tended to occur in such 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 Grada (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 of the positive check between the fourteenth and seventeenth 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 was not an individual fate. Instead, after bad harvests, the poor took to the roads in search of work or charity, spreading disease and social disorder ranging from petty crime to armed rebellion.[6] Apart from the dictates of religion and paternalistic ideals, governments had strong practical incentives to mitigate the impact of harvest failures on the poor.

In medieval times the main sources of charity were monasteries but, while the amounts disbursed appears to have been quite large (Rushton and Sigle-Rushton 2001, Slack 1989, 13), instead of rising after bad harvests, they seem to have been fairly constant, given to a fixed group of permanent dependents. Histo-

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[6]For the eighteenth century, Schellekens (1996) found that epidemics of typhus, a louse-borne disease of filth and overcrowding occurred in England in the aftermath of famines in neighbouring Ireland, while Galloway (1985) found that deaths 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 the sixteenth century, disorder ranging from serious riots to armed rebellion occurred after harvest failures (Leonard, 1900, xx).

rians see the beginning of a concern with public charity in the mid-sixteenth century, coinciding with falling real wages caused by rising population (compare Figure 1 on page 3). 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 that 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 in the form of wealthy individuals endowing institutions, and municipal in larger towns where local governments organized public granaries to provide subsidized grain to the poor 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, little action was taken to implement them until 1620s. During this time, the Personal Rule of Charles I, the state developed a short and highly 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 saw most of the more populous parishes implement a system of poor rates to subsidise local families in need of assistance, either long run because of young children, widowhood, or old age; or temporary because of illness, unemployment, or high food prices. 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 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, what he terms Deep

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 5: Mortality after bad harvests, 1541–1800.

Poverty. In other words it probably worked to keep the numbers of destitute people below a critical mass 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 7; 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 5 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 the absence of any mortality increases after 1709 and 1800 despite wheat prices increasing by half. However, it can equally be seen that the system was capable of being overwhelmed, especially when poor harvests were accompanied by epidemic illness which left large fractions of the population too ill to work, as in 1740 and, especially, 1728.

7   Conclusions.

A central puzzle in economic history has been the weak connection between living standards and mortality in existing studies that look at the period after the sixteenth century. This paper used data on inheritances to investigate the workings of the positive check between the thirteenth and fifteenth centuries, and found a very different pattern. Both during the low wage period preceding the Black Death, and the high real wage period of the fifteenth century, mortality shows an unstable, positive correlation, consistent with the spread of epidemic disease. Before the Black Death we found that falls in real wages caused by poor harvests of wheat were deadly at all levels of society.

That the weakening of the positive check in the sixteenth century and its disappearance during the seventeenth coincide with the emergence of the Poor Law and its evolution into its final form during the 1620s, leads us to agree with the Malthus of *On the Causes of the Present High Price of Provisions.* The Poor Law does appear to have limited the extent of outright starvation.

Given that the Poor Law did mitigate the impact of bad harvests, a natural extension would be to look directly at micro-data on the level of individual parishes, to see if local variations in spending correlate with differences in mortality. However, it is possible that if inadequate relief expediture drove people to vagrancy, so that they disappear from our records and possibly die elsewhere as a "poore unknowne wanderer", that local mortality may not be an effective way to measure the effectiveness of parish expenditure.

8   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/al

- Vital rates per 1,000 population from 1541 to 1870 are from Wrigley and Schofield (1981) Table A3.1.

- 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.

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