

# Population and Poverty in Ireland on the Eve of the Great Famine

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**ABSTRACT** We revisit the link between demographic pressure and economic conditions in pre-Famine Ireland and harness highly disaggregated parish-level data from the 1841 census in our analysis. The results indicate that on the eve of the Great Irish Famine of the 1840s, population pressure was positively associated with two measures of poverty—illiteracy and the prevalence of poor-quality housing. Malthus mattered in the sense that our results indicate that a “no population growth” scenario between 1800 and 1841 would have led to a 6% improvement in poor-quality housing and a 4% reduction in illiteracy. However, the strength of this relationship is reduced when additional explanatory factors are considered, and factors relating to location and economic geography offer greater explanatory power. Incorporation of data from the 1821 census reveals that in the two decades before 1841, population growth was fastest in areas under less population pressure, supporting the notion that preventive check forces were at play. These findings are consistent with some elements of Malthusian theory, although ultimately they refute the notion that overpopulation was the *principal* cause of pre-Famine Irish poverty.

**KEYWORDS** Famine • Malthus • Population • Ireland

## Introduction

Historical demography is commonly presented through the lens of the Malthusian model in which economic fortunes and population changes are trapped in a self-perpetuating back-and-forth cycle of growth and decay. The model’s appeal is that it provides a simple analytic framework explaining why population and living standards were incapable of sustained growth before the Industrial Revolution. Indeed, several grand theories of economic growth rely on Malthusian assumptions to generate models that explain how and why the Industrial Revolution occurred (see Clark 2007; Galor and Weil 2000; Hansen and Prescott 2002). That said, empirical assessments of the model’s efficacy in historical contexts are mixed. Early nineteenth-century Ireland is considered by some to be a poignant example of Malthusianism in action as overpopulation on the island paved the way for a catastrophic famine that “corrected” the island’s population. This study explores this issue and measures the

extent to which population pressure influenced living conditions in the years before the Great Famine.

It is widely accepted that the Great Famine of the mid-nineteenth century explains not only why the population of Ireland fell so dramatically from 1846 to 1850 but also why it continued to fall thereafter (O'Rourke 1995). Although many regions across Western Europe were affected by potato blight in the 1840s (Ó Gráda et al. 2007), none experienced anything like the devastation that befell Ireland, and that is because Ireland's dependence on the potato made it uniquely vulnerable to blight and constrained agricultural productivity long after 1850. But, ultimately, what made Ireland so vulnerable was poverty: a large portion of the island's inhabitants lived at a subsistence level and lacked any wealth or tangible financial assets. Economic backwardness and the failure of the population to recover in the post-Famine period suggest that Ireland's pre-Famine malaise was, at least in part, caused by overpopulation and thus Ireland would have been in a less precarious position on the eve of the Famine had the population been lower.

The historical consensus that overpopulation was the root cause of pre-Famine Irish poverty was endorsed by Connell (1950), who saw the introduction of the potato as a major catalyst for eighteenth- and early nineteenth-century Irish population growth. That growth, however, did not grind to a halt as the potato's value as a means of enriching the preexisting diet was exhausted; instead, underpinned by early marriage and high marital fertility, growth culminated in a dependence on the potato that was unmatched elsewhere, with ultimately apocalyptic consequences. This view was famously challenged by Mokyr (1980, 1985), who made the very salient point that previous analyses connecting Irish overpopulation and poverty lacked hard empirical evidence. Mokyr's analysis combined newly constructed county-level data (so  $n=32$ ) in a linear regression model in which income per capita (or a suitable proxy measure) was modeled as a function of population density (rural population per cultivated acre) and other measures.<sup>1</sup> Mokyr thus invoked cross-sectional data as proxies for points in time. Surprisingly, his results failed to support the overpopulation hypothesis: Irish counties with greater population per acre did not have lower income per capita. Mokyr's result remained robust across several different modeling specifications, leading him to conclude that economic historians should focus more on alternative reasons for pre-Famine Ireland's endemic poverty.

There was undoubtedly more than one reason for Irish poverty, but we believe that four decades on, Mokyr's approach to testing Malthus can be improved in several ways. In attempting to do this, like Mokyr we rely on the returns from the 1841 Irish population census (Great Britain 1843). However, our unit of analysis is the civil parish rather than the county, which increases the sample size from 32 to 2,437. The much higher resolution parish-level returns improve the accuracy of our estimates and allow for greater nuance between different specifications (*cf.* Brown and Guinnane 2007).

Another important difference, anticipated by McGregor (1989), is that our measure of population pressure relies on a better measure of land quality than that proposed by Mokyr (1985:47–48). We adjust for quality by dividing a parish's population by its Poor Law valuation (PLV). The PLV was a measure of the annual value of land and other hereditaments and formed the basis for the tax payable toward the

<sup>1</sup> See Figure A.1 in the online appendix for a map of Ireland's administrative boundaries.



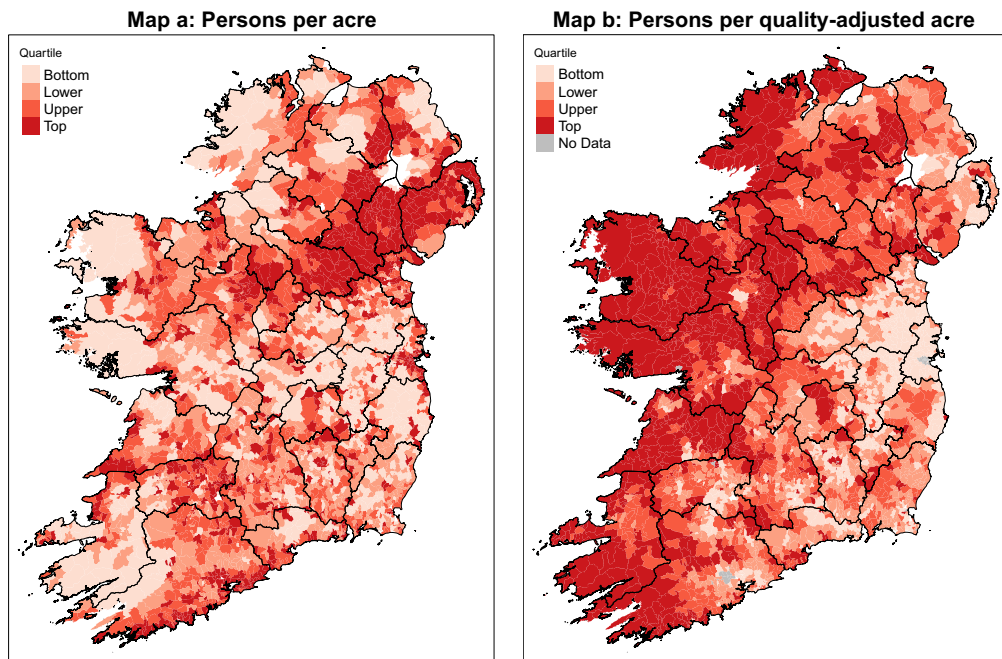


Fig. 1 Population density and population pressure in Ireland, 1841

support of the poor under the Irish Poor Law of 1838. Essentially a land value, it is a more accurate representation of population pressure than, for example, mean height above sea level or the proportion of land under cultivation. Intuitively, not all land is equal, and by adjusting for land quality via the PLV, we are accounting for differences in the natural carrying capacity of different parishes. The Figure 1 maps highlight the importance of adjusting for land quality. In map a, much of the west of Ireland seems “under”-populated, but this outcome is reversed in map b, which adjusts for quality using the PLV.

Measuring poverty is fraught with difficulty even in modern developed economies. This difficulty is compounded by data constraints in historical samples. We choose two measures of poverty in our analysis: illiteracy and the prevalence of low-quality (fourth-class) housing. The illiteracy data in the 1841 census, based on self-reporting and referring to the population aged five and older, reflect the strong regional variation in standards of living: whereas less than one in four in County Antrim in the northeast could neither read nor write, the corresponding proportion in County Mayo in the west was four in five (Great Britain 1843:xxxii).<sup>2</sup> The percentage of fourth-class houses—defined in the census as “all mud cabins having only one room”—ranged from 24.7% in County Down to 66.7% in County Kerry (Great Britain 1843:lvi–lviii). Maps a and b of Figure 2 illustrate the variation in these

<sup>2</sup> Our analysis considers those who can “read only” to be illiterate. The “read only” group accounts for 16.7% of the population surveyed on literacy. Our results are not sensitive to this assumption.

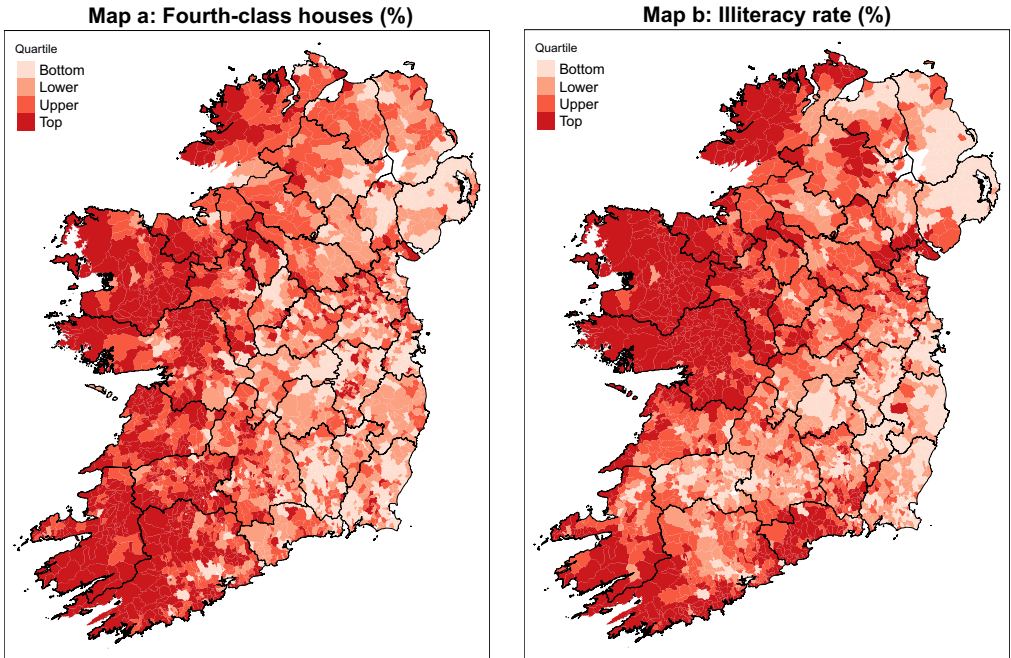


Fig. 2 Poor housing and illiteracy in Ireland, 1841

variables at the parish level, highlighting the desirability of higher resolution analysis. Both variables are correlated with one another, albeit imperfectly.<sup>3</sup>

The results from our regression analysis confirm that population pressure (defined as our population per quality-adjusted acre variable) is positively associated with illiteracy and poor-quality housing. Bivariate regressions, in which either illiteracy or poor housing is regressed on population pressure, reveal the existence of a strong association. However, the strength of this association is attenuated after we include additional explanatory variables to account for alternate sources of poverty. Geographic remoteness appears to be a key factor. Longitude (a proxy measure for distance to markets in Britain), the proportion of Irish speakers, and access to Ireland's navigable inland waterways (canals and rivers) pack a large explanatory punch. These variables might also be interpreted as remoteness from modern technologies and ideas, and the commercially useful English language. Similarly, institutional factors, captured by a variable measuring the proportion of individuals in a parish whose main source of income was "vested means," also appear to play a role.

At a glance, it appears that relative differences in market potential and poor institutions were as much to blame for Ireland's laggard economic status as overpopulation, if not more so. We quantify these differences using the relative importance methodology outlined in Lindeman et al. (1980). This technique stratifies the model's  $R^2$  statistic by explanatory variable and evaluates the relative contribution of each covariate to the explained variation. Our results show that population pressure explains 14% and

<sup>3</sup> The use of illiteracy data to measure poverty is also supported by Oxley (2004), who found a strong correlation between literacy and the heights of Irish-born female convicts sent to Australia prior to the famine.

16% of the variation in poor housing and illiteracy, respectively. Contrast this with the 30% and 21% contributions that longitude and the proportion of Irish speakers, respectively, make to poor housing or the 20% variation that the proportion of Irish speakers accounts for in the illiteracy regression. Translating our regression results onto a macro scale suggests that had Ireland's population not grown from 5 to 8.2 million between 1800 and 1841, both poor housing and illiteracy would have improved by only about 2.5 percentage points. Such outcomes are hardly consistent with the counterfactual that slower population growth in the eighteenth and early nineteenth centuries would have made Ireland substantially better off on the eve of the Famine. This finding squares with Mokyr's conclusion that economic historians should look beyond simple Malthusian models to understand Ireland's pre-Famine economy.

Our analysis also explores population dynamics. While the 1821 census report does not provide a one-for-one match of civil parishes in 1841 (mainly owing to boundary changes in the interim and to missing data for some parishes; J. Lee 1981), nearly three quarters of the parishes are traceable. Using this subsample of data, we repeat our regression analysis but decompose the population pressure variable into two parts: population pressure in 1821 and population pressure growth between 1821 and 1841. The estimated coefficients show that population pressure in 1821 predicts both poor housing and illiteracy in 1841, thus indicating that population pressure had a long-run influence. Yet population pressure growth also mattered, as parishes where population growth was highest were, conditionally, poorer in terms of both low-quality housing and illiteracy. We also analyze the trajectory of Irish population growth. Contrary to the view that sees the famine as a Malthusian catastrophe caused by an inexorable rise in population pressure in already overpopulated areas, our findings show that population pressure was reversing in the pre-Famine decades. Civil parishes under greater population pressure in 1821 exhibited substantially lower population pressure growth between 1821 and 1841. This finding supports the presence of a Malthusian preventive check operating in pre-Famine Ireland and therefore goes against the belief that the famine was a positive check caused by the absence of a preventive one.

## A Malthusian Model for Pre-Famine Ireland

The enduring appeal of the Malthusian model lies in its simplicity. The model can be summarized in two equations. The first models economic output  $Y_t$  at time  $t$  as a function of land  $X$ , labor  $L_t$ , and a constant  $A$  that measures technology or total factor productivity more generally. Thus, the variable  $AX$  can be thought of as quality-adjusted land units to capture the fact that not all land is equally fertile. Assuming constant returns to scale with the share parameter  $\alpha \in (0, 1)$  yields the following production function:

$$Y_t = (AX)^\alpha L_t^{1-\alpha}.$$

Defining poverty as when worker per output level  $p_t \equiv L_t / Y_t$  is low, and applying a log transformation results in the following poverty–population equation:

$$\log(p_t) = \alpha \log(L_t) - \alpha \log(AX),$$

where any increase in population increases poverty as  $\frac{\partial \log(p_t)}{\partial \log(L_t)} = \alpha > 0$ . The variable  $p_t$  can also be thought of as the inverse of the real wage. The second, or Malthusian check, equation provides the model's dynamic element:

$$\Delta L_{t+1} = \delta \log(p_t),$$

where the rate of population growth is negatively related to poverty  $\delta < 0$ .

The population check equation ensures that living standards can never rise in the long run. Imagine that a new farming technique such as crop rotation increases the productivity of land. If we set  $\alpha = 0.5$  and  $\delta = -0.5$ , an exogenous 10% increase in quality-adjusted land  $AX$  will reduce poverty by 5%. This increase in living standards will increase population growth by 2.5%, which in turn will increase the level of poverty  $p_t$  by 1.25%. One iteration of the model erodes a quarter of the initial economic gain and further iterations will percolate through the system and eventually wipe out all of the benefits.

The model predicts that regional population growth is proportional to the effective resources per capita, and this occurs to the (equilibrium) point where cross-regional living standards converge. In equilibrium, we would expect to find no cross-sectional relationship connecting population pressure and poverty. However, the equilibrium scenario also implies that population per effective resource should not exhibit substantial variation (i.e., where  $\sigma_{L_t/AX}^2 > 0$ ), something that clearly does not apply in our data as population pressure varied significantly across Irish parishes.<sup>4</sup> This feature of the data, as well as the marked population growth differences between 1821 and 1841 documented in the Results, implies that pre-Famine Ireland's population could not be characterized as being in a Malthusian equilibrium, thus validating the use of cross-sectional data in this application. Specifically, the model generates the following predictions:

1. Diminishing returns: across parishes, those with more population pressure on land will be poorer.
2. Population correction or check: population growth should be highest in parishes with lower population pressure.

The first predicts that the coefficient on a regression of poverty on population per quality-adjusted acre will be positive. Using a conventional measure of population density, such as population per acre, will confound the relationship between population and poverty as the model specifies that more people will tend to live in areas with more productive land. Furthermore, the model does not require that  $\alpha$  be fixed. Heterogeneity in  $\alpha$ , within the constant returns to scale range of zero to one, means that the cross-sectional estimate obtained from a poverty on population pressure regression represents an aggregate version of  $\alpha$ , as long as there is substantial variation in population pressure.

<sup>4</sup> Table 1 shows that our population pressure measure's standard deviation (0.51) is nearly as large as the sample mean (0.77).

The second prediction relates to the presence or absence of the Malthusian check mechanism. If population pressure reduces population growth, this supports the presence of checks. Those checks can be either positive (mortality) or preventive (fertility, migration). If the Great Famine was a positive check, this implies that the preventive checks, operating through fertility and migration, were absent or too weak to correct population pressure. Checks can manifest themselves in both directions. A positive-check relationship might mean that higher wages are reducing mortality or that lower wages are increasing mortality.

## Related Literature

When does an economy qualify as Malthusian? One common test is to estimate the short-run response of demographic variables to wage and price shocks, using time-series data. Works in this tradition on England include R. D. Lee (1981), Nicolini (2007), Crafts and Mills (2009), and Kelly and Ó Gráda (2012, 2014). Studies of other regions in the past include Weir (1984) on France, Fernihough (2013) on northern Italy, Pfister and Fertig (2010) on Germany, and Lagerlöf (2015) on Sweden. The empirical literature using variation in real wages or economic shocks along the time dimension appears to provide, at least, partial support for the Malthusian model. In England, the disappearance of both check mechanisms and major famines appears to have coincided with the beginnings of sustained economic growth in the seventeenth century. Similarly, the persistence of the check mechanisms in less industrialized regions of Europe into the nineteenth century is confirmed, although the disappearance of famine in Italy and in France preceded the beginnings of sustained economic growth in those countries (Alfani and Ó Gráda 2018).

Reliable time-series data permitting empirical studies like those cited are lacking for pre-Famine Ireland. Undeterred by this gap, Mokyr (1985) applied a cross-sectional approach. Mokyr's analyses regressed either income or wages on population pressure (defined as rural population per cultivated area, but using a range of proxies to control for land quality). While the population pressure variable appeared to influence economic conditions in several of Mokyr's regressions, this relationship was far from robust and led Mokyr to conclude that the pre-Famine economy should be viewed outside the narrow and simplistic scope of the Malthusian framework. More than 40 years have passed since Mokyr applied the cross-sectional approach to evaluate Malthus in Ireland, but other studies have done the same since. Examples include Ashraf and Galor (2011), who used historical cross-country data, and Verpoorten (2012), who used 1,294 small administrative units in Rwanda to look at the role of overpopulation in explaining the Rwandan genocide. Mokyr's results were questioned by McGregor (1989), who argued that incorporating a better measure of land quality yielded results more in keeping with traditional historical accounts of pre-Famine Ireland.

While Mokyr and McGregor relied on data collected at the county level ( $n=32$ ), we use the parish-level data collected in the 1841 census (so  $n=2,437$ ). Fotheringham et al. (2013) and Kelly and Ó Gráda (2015) have also used more disaggregated data—at the district electoral division ( $n>3,000$ ) and baronial ( $n>300$ ) levels, respectively—to estimate alternative versions of the Malthusian









living in the parish.<sup>6</sup> We also omit 45 urban parishes where land values either were not reported (e.g., values in Dublin city were reported on at a ward level) or were inaccurate because they related only to small rural portions within. We report the parish population in 1821 for 1,801 parishes listed in the 1831 census (Great Britain 1833). Boundary and name changes mean that we could not match all of the parishes exactly, although 74% of parishes provides us with good coverage linking both censuses.

In 1841, the average proportion of fourth-class (or lowest quality) housing across parishes was over 35%. As noted earlier, a typical fourth-class house was a windowless, one-room, mud cabin. Other houses were described as first-, second-, or third-class, depending on the number of rooms, windows, and building material. Parish-level illiteracy serves as our second measure of economic backwardness. Table 1 reports three measures of illiteracy: the full rate, the male rate, and the female rate. Here, illiteracy is defined as the proportion of the population aged five or older who could neither read nor write. We distinguish between male and female literacy because they potentially measure slightly different elements of child investment. Male literacy is more likely to reflect parent's investing in their son's education to boost their human capital and thus employment prospects in later life. This was less of a concern for females, and thus variation in female literacy is more likely to reflect education as a consumption good rather than an investment good among parents (Reis 2005).

There is quite a large overlap between poor housing and illiteracy. Figure 2 illustrates that, broadly speaking (but with some interesting exceptions, such as much of Waterford in the southeast), areas where literacy was high contained fewer fourth-class houses and vice versa. The strong association between the two variables underlines their relevance in measuring poverty across Ireland in 1841, as reflected in a strong bivariate correlation coefficient of .5.<sup>7</sup>

Earlier we introduced the concept of "population per quality-adjusted acre" as the most appropriate measure of population pressure. More conventional accounts, such as that used in Mokyr (1985), use population per cultivated acre as a measure of population pressure. However, we reason that population per value-adjusted acre is a superior measure because all land is not equal. In two equally populated parishes, the parish with poorer land faces greater population pressure. In essence, this relationship is about the carrying capacity of land, whereby parishes with a higher valuation will *ceteris paribus* be able to support a larger population. This distinction is also incorporated into the earlier section on the Malthusian model because economic output is a function of  $AX$ , not just land  $X$ . This relationship is supported empirically in our data. The bivariate correlation coefficient between population per acre and value per acre

<sup>6</sup> The distinction between rural and nonrural parish populations is of no consequence to our analysis. Controlling the nonrural parish share does not alter any of our regression estimates. Similarly, our results are qualitatively identical (see Table D.1 in the online appendix) when we replicate our analysis on a subset of the data that consists only of parishes with an entirely "rural" population.

<sup>7</sup> The relationship between these two variables was so apparent that it prompted the following quote from the Census Commissioners Report when discussing education: "The remarkable accordance of this map with that which represents house-accommodation is very striking. It is, however, beyond our province to discuss the circumstances which may tend to perpetuate the lower class of houses. Still we may observe, that bad house-accommodation and defective education seem to accompany each other. But whether the one or the other be cause or effect, there can be little doubt that the removal of either would be soon followed by the amelioration of the other" (Great Britain 1843:xxxiii).

(both expressed in natural logs) is .35. Better quality land is strongly associated with a greater population density, although not perfectly, and it is this residual that forms the basis of whether a parish is considered over- or underpopulated. For example, a parish with a greater population density than its value per acre is, in relative terms, considered overpopulated.<sup>8</sup>

We use the land values reported in the 1851 census (Great Britain 1856) as our measure of land quality.<sup>9</sup> This measure, known as the Poor Law valuation of the land in question, determined the rate to be paid by the landowner for local poor relief. Between 1847 and 1864, the results of a second highly detailed survey of Irish land values were published for each of Ireland's 32 counties. These surveys were diligently constructed under the stewardship of Sir Richard Griffith, a geologist employed by the government to provide a database of land values throughout Ireland. Griffith's valuation came too late for the Irish Poor Law of 1838, which had to rely on an alternative, less thorough, valuation. To provide a basis for the taxation that would underpin the costs of maintaining the poor, the authorities charged the Board of Guardians of each of Ireland's 130 Poor Law Unions with assessing, at a townland level, the net (repairs, insurance, and taxes were deductible) annual value of all hereditaments. The interpretation and implementation of this instruction varied somewhat from union to union, although assessments were open to appeal. Furthermore, the land value also depended on the local price of produce. In theory, two estates with the same quality and quantity of land could have different land values if the price of agricultural goods differed in local markets. Also, we would expect more urbanized parishes, those with villages and towns, to have higher land values, and differences could also emerge as a result of market potential. For example, a parish farther from a town or city would have a lower land value regardless of land quality.

The PLV provides an exceptionally high resolution snapshot of land quality in Ireland. Its application as a deflator of population pressure entails several drawbacks, however. Fortunately, we can address these limitations. In online Appendix B we show that the PLV is strongly correlated (correlation coefficient of .83) with a sample of parishes from Griffith's survey. This appendix also illustrates the low regional variation in potato prices across Ireland between 1840 and 1846, which helps alleviate concerns that variation in values was caused by price dispersion. Throughout our analysis we include a basic control for the "nonrural" share to account for the confounding effect of urbanization on land values. We also tackle the threat that urbanization poses by rerunning our main analysis on a subsample ( $n=1,429$ ) of "rural only" parishes, that is, those without a designated town or village. The result of this analysis, shown in Table D.1 in the online appendix, confirms that our findings are not

<sup>8</sup> The difference between population density and population pressure is highlighted by comparing two parishes: Kilpatrick in Cork and Kiltteevoge in Donegal. In 1841, Kilpatrick had a population of 1,081 people living on 2,664 acres of land, whereas Kiltteevoge's population was 4,864 people across 41,132 acres. Thus, Kilpatrick was four times more densely populated than Kiltteevoge, at 0.4 people per acre compared to 0.1 per acre. However, Kilpatrick's PLV came to £1,443, whereas the equivalent value for Kiltteevoge, 15 times greater in size, was £4,240. The person per land value for Kilpatrick was 0.8 per pound and that for Kiltteevoge was 1.1 per pound. When we adjust for land quality, Kiltteevoge is under greater population pressure than Kilpatrick.

<sup>9</sup> While these values are reported for 1851, they are unaffected by the Famine as the valuations used for Poor Law rates were applied in the early 1840s (Cousens 1960).

unduly affected by urban–rural distinctions in land values. Overall, we believe that the PLV provides a plausible portrayal of land quality in pre-Famine Ireland.

Table 1 also features additional variables used as explanatory covariates in our regression models. The east–west division is apparent in Figures 1 and 2. Both figures strongly suggest that remoteness, economic geography, and market potential play important roles, a topic stressed in development economics (Redding and Sturm 2008). To capture this potentially offsetting factor, our data set includes both longitude and latitude. Another measure of remoteness/market potential is the distance between each parish and various points of economic importance. With this in mind, we include a measure of the distance to the nearest town (towns are designated as civil parishes with an urban population of more than 2,000 people). We also include variables that measure the minimum distance to an eighteenth-century turnpike road, as detailed in Broderick (2002), and to a canal or navigable waterway, as defined in the appendix of the Vice-Regal Commission on Irish Railways report of 1906 (Great Britain 1907).<sup>10</sup>

The economic structure of each parish is captured by a variable measuring the proportion of household heads (assumed to be the chief breadwinner) employed in agriculture. Ireland's pre-Famine economy was overwhelmingly rural, so it is no surprise that most household heads (around 75%) were employed in this dominant sector. Manufacturing and trade occupations account for a further 17% of the economy, with "other" (mainly commerce and service) occupations representing the residual 8%. While parishes differed in the proportions of employment dedicated to manufacturing and "other" occupations, this distinction was irrelevant in our econometric results and so we focus on the proportion in agriculture. The economic structure, and the potential for urban–rural differences to confound land values, is further represented by the variable "nonrural population share," a measure of the proportion of the parish population living in nonrural settlements of various sizes. The "vested means" variable measures the proportion of families whose livelihoods are "chiefly dependent on vested means, professions, etc." as distinct from depending on either "the direction of labour" or "their own manual labour." Owners of more than 50 acres of land fell into this category, alongside a small number of others with substantial wealth or capital. This measure represents the local presence of an elite represented by white-collar occupations and rentiers, and hence is a proxy for social capital. Vested means, which is subject to a strong east–west gradient, can also be seen as a marker (albeit an imperfect one) for investment in schools, medical facilities, and other infrastructure. It also captures the "absentee landlord" effect, as one would expect a very low vested means value to reflect the absence of landholders.<sup>11</sup>

The parish sex ratio variable (the ratio of the male population aged five or older to the equivalent female population) provides a proxy indicator of migration, as gender-selective migration has the potential to skew sex ratios. Parishes with fewer men

<sup>10</sup> These data predate the construction of Ireland's railroad network, as by 1840 only 21 km of track had been laid (Mitchell 2013).

<sup>11</sup> We also experimented with a variable describing the percentage of properties in an area auctioned in the Encumbered Estates Court in the wake of the Famine (Eiriksson and Ó Gráda 1995) as a yardstick for the institutional quality of land management. However, this variable, available only at the more aggregated baronial level (Ireland's 331 baronies were composed of multiple civil parishes), lacked explanatory power and so we excluded it from the analysis.

tended to be more urban with a lower concentration of agricultural employment, suggesting that “missing women” is symptomatic of emigration. [Table 1](#) indicates that, on average, there were 99 men for every 100 women in each parish, and this ratio had a standard deviation of 9.

We also add measures capturing the religious composition and the proportion of Irish-language speakers of each parish. Unfortunately, the 1841 and 1851 censuses did not survey religion or language. Data on religion for 1834 exist, but these have yet to be fully digitized and mapped. Thus, to incorporate these variables we invoke the 1901 census (National Archives of Ireland 2019), from which we have data on the religious and linguistic (whether the respondent could speak Irish or was bilingual) makeup of Ireland’s District Electoral Divisions (DEDs), which in turn we superimpose on our parish data.<sup>12</sup> That a 60-year gap exists between our data set and both variables is of concern. We can partially mitigate such concerns by using only 1901 census data on individuals born before 1845 (56 years or older). While selective Famine and post-Famine mortality and migration are still issues worth consideration, several facts help to alleviate our worries regarding these. The most important feature of these data is that they are shares, and as such, they are unaffected by absolute changes in the population. For example, if the population of a parish that was entirely Catholic and Irish-speaking is halved, the population shares of both variables will remain unchanged.<sup>13</sup> That more than one fifth of parishes in our data had populations in which more than 80% were Irish speakers underlines this, because we are still able to identify a large number of Irish-speaking communities in our data. Indeed, we find that the spatial variation of Ireland’s pre-independence demography did not change much over time. For example, the proportion of Catholics was largely unchanged throughout Ireland’s four provinces between 1861 and 1911 (Fernihough et al. 2015).<sup>14</sup> Likewise, Gregory and Cunningham (2016) found that the Famine had an almost negligible impact on the share of Catholics across Ireland’s 32 dioceses.<sup>15</sup>

## Results

### Population Pressure

We estimate the effect of population pressure on poverty via the following linear regression model:

<sup>12</sup> We interpolate using areal-weighted methods. This procedure overlays our two polygon shapefiles and assigns a value for each religion and Irish-language measure on the basis of the proportion of each DED that lies within each civil parish boundary. For example, imagine a parish overlaps two DEDs and its landmass comprises 25% of the first DED and 75% of the second. If the first and second DEDs’ Catholic shares were 80% and 70%, respectively, our areal-weighting schema would deduce that the Catholic proportion in this parish is 75% (80%) + 25% (70%) = 77.5%.

<sup>13</sup> A possible caveat here is that not knowing English deterred some from leaving, since it reduced the gains from migration. However, the great majority of Irish speakers in our data were bilingual in 1901.

<sup>14</sup> Although the share in Ulster fell by 6.8 percentage points, from 50.5% to 43.7%.

<sup>15</sup> Figure 1 in Gregory and Cunningham (2016) is a scatterplot showing the Catholic share in 1834 against the same variable in 1861. The reported regression line ( $\hat{y} = 0.06 + 0.99x$  with a goodness-of-fit  $R^2 = .98$ ) shows an almost one-for-one relationship between the two variables.

$$Poverty_i = \alpha + \beta \log(PopPressure_i) + X\gamma + \varepsilon_i,$$

where  $Poverty_i$  in civil parish  $i$  is measured in terms of either the prevalence of fourth-class housing or illiteracy,  $\log(PopPressure_i)$  is the natural logarithm of  $i$ 's population per quality-adjusted acre, and  $X$  denotes a matrix of additional explanatory variables.<sup>16</sup> To simplify our interpretation, we transform all variables into  $z$  scores. This means that all coefficients represent the influence of a one-standard-deviation change on either poor housing or illiteracy, which are also expressed in standard deviations. Thus, we can compare the relative influence of each covariate without having to reference the unit of measurement or scale. Similarly, because both outcome variables are expressed in  $z$  scores, we can compare across, as well as between, regression model results.

The first column in [Table 2](#) reports the results from a simple bivariate ordinary least-squares (OLS) regression of the fourth-class housing share on population pressure, as measured by population per quality-adjusted acre of land. The coefficient is both relevant and statistically significant, as a one-standard-deviation increase in population pressure is associated with a 0.415 increase in the prevalence of poor housing. Once control variables are included in the model specification, as in column 2, the population pressure variable's influence attenuates substantially. The reported coefficient in column 2 is 0.122, and it is reasonable that one would attribute over half of the importance of population pressure in column 1 to confounding factors. Longitude—how far east the parish's location is—appears to exert the most explanatory power in this specification, as movement from east to west increases the share of fourth-class houses. Similarly, the various markers of rural status, perhaps unsurprisingly, indicate that poor housing tended to be found in parishes that were farther from towns, had larger numbers employed in agriculture, and had smaller “nonrural” populations (i.e., people living in villages or towns). Transport infrastructure matters too.

Being farther away from Ireland's waterway network predicts poor housing, although the reverse is true for turnpike roads. Once you control for waterway access, as well as other explanatory variables, access to the turnpike road network does not help, and possibly hinders, economic progress. This result tells us that roads were, at most, a poor substitute for water-based transport. Indeed, most of pre-Famine Ireland's bulky freight was carried along canals and navigable waterways, as roads could accommodate only passengers and light freight (Lee 1976).

Column 3 of [Table 2](#) introduces Poor Law Union (PLU) fixed effects into the model. These are the administrative boundaries upon which the land values may have varied systematically owing to differences in the competency or integrity of the local evaluators. Similarly, PLU fixed effects also mitigate against spatial differences in census enumeration and potential population undercounting as a confounding force. These fixed effects control for all variation between Ireland's 130 PLUs, meaning that the coefficients measure the strength of these relationships on the basis of variation

<sup>16</sup> This transformation occurs after we log-transform the population pressure and distance to turnpike, waterway, and town variables. We find that the pre- $z$ -score log transformation reduces skewness in these variables.



**Table 2** Ordinary least-squares regressions of poor housing (%) and illiteracy (%) on population pressure and other covariates

	Fourth-Class Houses (%)			Illiteracy (%)		
	(1)	(2)	(3)	(4)	(5)	(6)
Population Pressure	0.415** (0.051)	0.122** (0.036)	0.194** (0.041)	0.503** (0.073)	0.281** (0.043)	0.272** (0.026)
Longitude		-0.353** (0.062)	-0.094 (0.193)		0.078 (0.080)	-0.188 (0.127)
Latitude		0.101 <sup>†</sup> (0.053)	-0.216 (0.281)		0.278** (0.060)	-0.121 (0.188)
Turnpike Distance		-0.050 (0.036)	-0.060 (0.053)		0.069 (0.043)	0.039 (0.032)
Waterway Distance		0.138** (0.039)	0.048 (0.031)		-0.024 (0.045)	-0.082** (0.027)
Town Distance		0.081** (0.028)	0.060** (0.022)		-0.014 (0.021)	0.018 (0.017)
Agricultural Employment		0.006 (0.032)	0.051 <sup>†</sup> (0.030)		0.146** (0.055)	0.157** (0.037)
Roman Catholic		0.031 (0.047)	0.104** (0.039)		0.392** (0.071)	0.323** (0.043)
Irish-Speaking		0.148* (0.060)	0.272** (0.063)		0.391** (0.068)	0.284** (0.063)
Vested Means		-0.076** (0.028)	-0.078** (0.028)		-0.156** (0.032)	-0.163** (0.034)
Sex Ratio		0.010 (0.019)	-0.012 (0.018)		-0.059** (0.019)	-0.052** (0.020)
Nonrural Population Share		-0.091** (0.032)	-0.091** (0.028)		-0.101* (0.041)	-0.075** (0.029)
PLU Fixed Effects	No	No	Yes	No	No	Yes
Number of Observations	2,437	2,437	2,437	2,437	2,437	2,437
R <sup>2</sup>	.172	.442	.580	.253	.655	.782
Adjusted R <sup>2</sup>	.172	.439	.548	.253	.653	.765

Notes: Columns 1–3 and 4–6 regress the fourth-class housing and illiteracy variables on the indicated covariates. Dependent variables and all covariates are expressed in terms of z scores (a one-unit change represents a one-standard-deviation change). The variables representing population pressure and road, waterway, and town distances were log-transformed (to remove skewness) before the z-score transformation. Conley standard errors allowing for spatial correlation within a 25-km radius are shown in parentheses. PLU = Poor Law Union.

<sup>†</sup>*p* < .10; \**p* < .05; \*\**p* < .01

at a local level. In other words, the variation driving these results occurs within each PLU, meaning the results can only be the result of differences between neighboring civil parishes. Despite the extra explanatory power, the inclusion of the PLU-level fixed effects results in a larger population pressure coefficient. Most of the other results are intact in this specification, although the longitude coefficient is no longer statistically significant. Does this mean that longitude is unimportant? Probably not, because the PLU fixed effects will incorporate the majority of the variation in longitude in our sample. A naive least-squares dummy variable regression of longitude on PLU dummy variables yields an *R*<sup>2</sup> of .99, meaning that 99% of the parish-level

variation in longitude is explained by PLU fixed effects. The same is not true for our population per quality-adjusted land variable, as the PLU fixed effects account for less than two thirds of the variation in population pressure ( $R^2 = .64$ ). Given these facts, the most plausible explanation for our results is that population pressure influences poor housing at a micro sub-PLU level, whereas the strength of the longitude variable is primarily driven by differences between parishes as a higher level of aggregation than the PLUs.

Columns 4 to 6 replicate the modeling performed in columns 1 to 3 except replace the fourth-class housing variable with illiteracy. The results are broadly similar, although population pressure appears to matter more as the coefficients effectively double in size. The variables measuring culture—proportions Roman Catholic and Irish-speaking—are more prominent, as both are positively associated with the level of illiteracy. The link between the Irish language and illiteracy (measuring the inability to both read and write without a language distinction) is noteworthy. A baronial analysis performed by Ó Gráda (2013) suggests a link between Irish-speaking and low school attendance, although it was not unknown for schools to operate via the medium of the native language (Ó Ciosáin 1997:155–157). The positive relationship between Catholicism and illiteracy is in line with existing research linking the importance of Bible-reading to mass schooling and literacy (Landes 1999:178), and the presence of Sunday Schools in heavily Presbyterian Ulster evidently contributed to the Catholic–Protestant literacy gap found there.<sup>17</sup> This religious difference is greatly diminished in column 3 as PLU fixed effects are introduced, a finding that points to this religious difference being more important at a lower spatial resolution. The presence of local elites, captured with the vested means variable, also matters for illiteracy. In this context, illiteracy predates the foundation of the national education system, so it seems reasonable to speculate that local elites, or nonabsentee landlords, may have played a role in funding education provision for poorer families. Finally, while the sex ratio variable is statistically significant, we find that this result is explained by the male–female literacy gap. Men were less likely to be illiterate, so as the ratio of males increases, illiteracy is reduced. Once we perform male and female illiteracy regressions separately, the results of which are displayed in Table C.1 of online Appendix C, we find that the influence of the sex ratio variable vanishes.

The results in Table 2 support the existence of a negative population pressure effect in pre-Famine Ireland. Both poor housing and illiteracy were higher in parishes where population pressure was greater. However, this effect appears to be modest in both relative and absolute terms. Table 3 presents the results of an auxiliary relative importance procedure applied to the regression models reported in columns 2 and 5 of Table 2. This procedure, defined in Lindeman et al. (1980), calculates the contribution of each explanatory variable to the explained variation in both fourth-class housing and illiteracy.<sup>18</sup> As is evident in Table 3, population

<sup>17</sup> Our data suggest that Protestants from both the Church of Ireland and Presbyterian congregations were equally likely to be literate. A supplementary regression (not shown) reveals that no (conditional) illiteracy difference existed between parishes that had a larger Church of Ireland population compared to Presbyterian devotees.

<sup>18</sup> Note that both columns in Table 3 add to (approximately) 100 as they measure the contribution to the explained part of the variation in both outcomes. The model  $R^2$  values indicate that around 41%

**Table 3** Relative importance metrics

	Fourth-Class Houses (%) (1)	Illiteracy (%) (2)
Population Pressure	14	16
Longitude	30	11
Latitude	2	5
Turnpike Distance	2	5
Waterway Distance	11	3
Town Distance	4	3
Agricultural Employment	5	9
Roman Catholic	4	15
Irish-Speaking	21	20
Vested Means	4	9
Sex Ratio	1	1
Nonrural Population Share	3	4

*Notes:* Columns 1 and 2 report the relative importance (the contribution of each coefficient to the explained variation in the model) of each covariate from the regression models reported in the second and fifth columns, respectively, of [Table 2](#).

pressure can explain only a relatively small (between 14% and 16%) part of the variation in both variables. Longitude and the prevalence of Irish speakers are individually more influential.

What do our coefficients mean in absolute terms? If we replicate our analysis in columns 2 and 5 without applying the  $z$ -score transformation to the population pressure variable, we can estimate this relationship in terms of partial elasticities. This analysis yields coefficients of 0.191 and 0.440, respectively. In other terms, a 100% increase in population pressure is associated with a 0.19- and 0.44-standard-deviation rise in poor housing and illiteracy, respectively.<sup>19</sup> Between 1800 and 1841, the population of Ireland rose by approximately 64%, from 5.0 to 8.2 million (Daultrey et al. 1982). A simple back-of-the-envelope calculation suggests that had Ireland experienced no population growth in the first four decades of the nineteenth century, there would have been an improvement of only  $0.64 \times 0.191 \times 18.142 = 2.2$  percentage points in poor housing (i.e., the average share of fourth-class houses in a parish would have been 33.2%, not 35.4%). The equivalent calculation for illiteracy suggests a difference of  $0.64 \times 0.439 \times 9.670 = 2.7$  percentage points. The modest counterfactual values demonstrate that while population pressure was relevant, overpopulation was not the principal cause of Irish poverty.<sup>20</sup>

and 58% of the variation in fourth-class housing and illiteracy, respectively, is accounted for by the covariates.

<sup>19</sup> Results are not shown but are available upon request.

<sup>20</sup> Our counterfactual calculations rely on estimates from the conditional models that control for potential confounders. One criticism of this approach is that it potentially underestimates the population pressure coefficient in cases where population pressure's influence is erroneously channeled through covariates. However, if we replicate this exercise adopting an unconditional approach omitting other explanatory variables, we find counterfactual reductions of 7.5 and 4.9 percentage points for poor housing and

**Table 4** Comparing population pressure in 1841 with that in 1821

	Fourth-Class Houses (%)		Illiteracy (%)	
	(1)	(2)	(3)	(4)
Population Pressure, 1841	0.095** (0.033)		0.296** (0.048)	
Population Pressure, 1821		0.085* (0.036)		0.304** (0.048)
Population Pressure Growth, 1821–1841		0.106** (0.028)		0.188** (0.037)
Baseline Controls	Yes	Yes	Yes	Yes
Number of Observations	1,801	1,801	1,801	1,801
$R^2$	.463	.466	.687	.687
Adjusted $R^2$	.460	.462	.685	.685

*Notes:* Columns 1–2 and 3–4 regress the fourth-class housing and illiteracy variables on the indicated covariates. Dependent variables and all covariates are expressed in terms of  $z$  scores (a one-unit change represents a one-standard-deviation change). The variables representing population pressure and road, waterway, and town distances were log-transformed (to remove skewness) before the  $z$ -score transformation. Conley standard errors allowing for spatial correlation within a 25-km radius are shown in parentheses.

\* $p < .05$ ; \*\* $p < .01$

## Population Growth

We now introduce the 1821 population data to analyze dynamics. [Table 4](#) splits the population pressure variable into two components: population pressure in 1821 and the growth in this variable occurring from 1821 to 1841. In columns 1 and 3 we rerun the regression models from columns 2 and 5 of [Table 2](#) after excluding the civil parishes with missing 1821 population data. Both coefficients are similar to their predecessors in [Table 2](#), so it is safe to conclude that this subset of data is free from sample selection concerns.<sup>21</sup> The 1821 population pressure coefficients are equivalent to their 1841 counterparts. The coefficient estimates associated with the population pressure growth tell a similar story. The influence of population pressure on poverty in 1841 was a function of both preexisting land pressure and population growth.

Both channels appear to be equally prominent, and it is important to stress that these are conditional effects. For example, if population growth were zero in every parish between 1821 and 1841, population pressure at the start of this period has as

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illiteracy, respectively. Even in this scenario, population pressure appears to have only a moderate influence on pre-Famine living conditions.

<sup>21</sup> The model specification implicitly assumes that the explanatory variables are time-invariant. That seems plausible except, perhaps, in the case of agricultural employment, where deindustrialization might have forced some return to the land, particularly in north Connacht and south Ulster. However, this change would have resulted in changes in population pressure and thus including it would potentially obscure the population pressure effect (although the fact that the population pressure is larger in magnitude when control variables are introduced suggests that deindustrialization is nonconfounding).

**Table 5** Regressions of population change over the 1821–1841 period on indicated covariates

	(1)	(2)
Population Pressure 1821	−0.350*** (0.094)	−0.718** (0.086)
Longitude		−0.456** (0.073)
Latitude		0.195** (0.061)
Turnpike Distance		0.135* (0.054)
Waterway Distance		−0.046 (0.050)
Town Distance		0.066* (0.027)
Agricultural Employment		−0.128* (0.062)
Roman Catholic		0.001 (0.050)
Irish-Speaking		0.154* (0.063)
Vested Means		−0.193** (0.057)
Sex Ratio		−0.077* (0.038)
Nonrural Population Share		0.182** (0.051)
Number of Observations	1,801	1,801
$R^2$	.123	.383
Adjusted $R^2$	.122	.379

*Notes:* Columns 1 and 2 regress population pressure growth (the difference between population per adjusted land value in 1821 and 1841) on the indicated covariates. The dependent variable and all covariates are expressed in terms of  $z$  scores (a one-unit change represents a one-standard-deviation change). The variables representing population pressure and road, waterway, and town distances were log-transformed (to remove skewness) before the  $z$ -score transformation. Conley standard errors allowing for spatial correlation within a 25-km radius are shown in parentheses.

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$

much predictive power as the 1841 variable. Similarly, if all parishes were subject to the same level of population pressure in 1821, growth in population pressure thereafter offers as much explanatory power as static population pressure measured in 1821. The level of poverty we see in 1841 is due to both long-run pressure on land and more recent population changes.

The Malthusian check mechanism corrects population pressure. When applied to this context, parishes under more population pressure in 1821 should have had a slower population growth trajectory thereafter. While [Table 4](#) reaffirms our previous finding of the presence of “diminishing returns,” it does not reveal whether population change in the decades leading up to the Famine occurred in a Malthusian fashion, with checks, or in a non-Malthusian fashion, with the absence of checks. [Table 5](#) demonstrates unambiguous support for this hypothesis. Population pressure in 1821

appears to have a strong negative influence on population pressure growth in the subsequent two decades. The conditional elasticity (estimated on a separate regression without the *z*-score transformation) of  $-0.43$  indicates that a 1% increase in population pressure in 1821 is associated with a 0.43% decrease in subsequent population growth. Furthermore, the postestimation relative importance analysis reveals that nearly two thirds (62%) of the explained variation in population growth is due to the initial population pressure. This adjustment is more likely to have been the product of changes in the marriage rate and in out-migration rather than a change in the death rate, although hard evidence is wanting (Boyle and Ó Gráda 1986; Ó Gráda 1994:69–76).

If we assume that pre-Famine Ireland was Malthusian, the results in Tables 4 and 5 present us with a paradox. On one hand, Table 4 tells us that if population pressure restricted economic prosperity, this land pressure was a deeply embedded long-run phenomenon, as the population pressure in 1821 has a similar degree of predictive power as that in 1841. On the other hand, Table 5 indicates that the population check mechanism, which dictates the speed at which change occurs, was highly relevant, as land pressure in 1821 is associated with reduced population growth between 1821 and 1841. However, although the means to correct population pressure existed, they were not applied with sufficient force. Tragically, the population checks at work in Ireland before the Famine were too weak to allay an unforeseen and lasting ecological shock like the potato blight.

## Conclusions

In the wake of the Great Irish Famine, land agent William Steuart Trench informed his friend the economist Nassau Senior (Senior 1868):

It was an awful remedy. The country wore a delusive appearance of prosperity. Capital had been accumulating—rents had risen, and were well paid . . . the value of property was increasing; but all this time the population was increasing more rapidly than the capital that was to maintain and employ it. . . . Such were its numbers that it seemed irrevocably doomed to the potato. . . . Nothing but the successive failures of the potato, its failure season after season, could have produced the emigration which will, I trust, give us room to become civilised.

That stark Malthusian interpretation of Irish backwardness on the eve of the Great Famine has often been re-echoed since, in Ireland and further afield (e.g., Caldwell 1998; Galbraith 1977:37–38; O'Brien 1921; Solow 1971:196), and it was the conventional wisdom when contested by Joel Mokyr in the early 1980s (Mokyr 1980, 1985). Mokyr interpreted the outcome of his research as casting “serious doubt on the simple and easy explanation that blames Irish poverty on excess population” (Mokyr 1985:51). His work elicited widespread reaction and further econometric analyses (Fotheringham et al. 2013; Goodspeed 2016; Kelly and Ó Gráda 2015; McGregor 1989; Mokyr 1985; O'Rourke 1994; Solar 1989, 2015).

In this article, we address the issue anew, using new data and new variables. The link between population pressure and living standards on the eve of the Famine is



reasserted, but its quantitative impact turns out to be modest. We also provide evidence for a role for factors that might be interpreted as reflecting geography and human agency or institutions. First, we show that location mattered: trying to eke out a living on an acre of any given quality of land was much tougher in the west of the country than in the east. Living in a remote area presumably meant distance not just from commodity markets, but also from government services, educational facilities, and exposure to new techniques and ideas. Second, we show that the local presence of such a “leisure class”—an elite dependent on “vested means” in the form of property or accumulated or inherited wealth—was associated with lower levels of poverty, particularly illiteracy. It seems plausible to assume that such an elite could have added to social capital, provided nonagricultural employment, or subsidized emigration. Absentee landlords were less likely to have provided these services. Third, we show that the effect of population per adjusted acre was (conditionally) homogeneous and robust to the inclusion of a large number of control variables and a battery of econometric procedures. That this effect persists in the presence of Poor Law Union fixed effects is intriguing. It appears that the population pressure effect exists at a local level, proving both the importance and the value of using highly disaggregated parish data. Fourth, we find no evidence that the population growth in the 20 years before the Famine was responsible for Ireland’s pre-Famine economic malaise. Substituting the 1821 level of population instead of the 1841 population leaves the coefficients relatively unchanged. Finally, we find strong evidence that supports the presence of a preventive check. This finding goes against the view that Ireland’s population was growing unsustainably in the decades leading up to the Famine.

Our results support the presence of both diminishing returns to population and the Malthusian check mechanism in pre-Famine Ireland. However, Irish poverty was also a function of numerous other factors, as well as overpopulation. Furthermore, the presence of a strong preventive check, as found here, is inconsistent with the Famine being a positive check event caused by overpopulation in the absence of preventive checks. ■

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## References

- Alfani, G., & Ó Gráda, C. (2018). The timing and causes of famine: The European experience. *Nature Sustainability*, 1, 283–288. <https://doi.org/10.1038/s41893-018-0078-0>
- Almqvist, E. L. (1979). Pre-famine Ireland and the theory of European proto-industrialization: Evidence from the 1841 census. *Journal of Economic History*, 39, 699–718.
- Ashraf, Q., & Galor, O. (2011). Dynamics and stagnation in the Malthusian epoch. *American Economic Review*, 101, 2003–2041.
- Bourke, P. M. A. (1959–1960). The extent of the potato crop in Ireland at the time of the Famine. *Journal of the Statistical and Social Inquiry Society of Ireland*, 20(Part 3), 1–35.
- Boyle, P., & Ó. Gráda, C. (1986). Fertility trends, excess mortality, and the Great Irish Famine. *Demography*, 23, 543–562.

- Broderick, D. (2002). *The first toll roads: Ireland's turnpike roads 1729–1858*. Cork, Ireland: The Collins Press.
- Brown, J. C., & Guinnane, T. W. (2007). Regions and time in the European fertility transition: Problems in the Princeton Project's statistical methodology. *Economic History Review*, 60, 574–595.
- Caldwell, J. C. (1998). Malthus and the less developed world: The pivotal role of India. *Population and Development Review*, 24, 675–696.
- Clark, G. (2007). *A farewell to alms: A brief economic history of the world*. Princeton, NJ: Princeton University Press.
- Conley, T. G. (1999). GMM estimation with cross sectional dependence. *Journal of Econometrics*, 92, 1–45.
- Connell, K. H. (1950). *The population of Ireland, 1750–1845*. Oxford, UK: Clarendon Press.
- Cousens, S. (1960). The regional pattern of emigration during the Great Irish Famine, 1846–51. *Transactions and Papers (Institute of British Geographers)*, 28, 119–134.
- Crafts, N. F. R., & Mills, T. C. (2009). From Malthus to Solow: How did the Malthusian economy really evolve? *Journal of Macroeconomics*, 31, 68–93.
- Daultrey, D., Dickson, D., & Ó Gráda, C. (1982). Hearth tax, household size and Irish population change 1672–1821. *Proceedings of the Royal Irish Academy*, 82, 125–181.
- Eiriksson, A., & Ó Gráda, C. (1995). *Estate records of the Irish Famine*. Dublin, Ireland: Irish Famine Network.
- Fernihough, A. (2013). Malthusian dynamics in a diverging Europe: Northern Italy, 1650–1881. *Demography*, 50, 311–332.
- Fernihough, A., Ó Gráda, C., & Walsh, B. M. (2015). Inter-marriage in a divided society: Ireland a century ago. *Explorations in Economic History*, 56, 1–14.
- Fotheringham, A. S., Kelly, M. H., & Charlton, M. (2013). The demographic impacts of the Irish Famine: Towards a greater geographical understanding. *Transactions of the Institute of British Geographers*, 38, 221–237.
- Galbraith, J. K. (1977). *The age of uncertainty*. Boston, MA: Houghton Mifflin.
- Galor, O., & Weil, D. N. (2000). Population, technology, and growth: From Malthusian stagnation to the demographic transition and beyond. *American Economic Review*, 90, 806–828.
- Goodspeed, T. B. (2016). Microcredit and adjustment to environmental shock: Evidence from the Great Famine in Ireland. *Journal of Development Economics*, 121, 258–277.
- Great Britain. (1833). *Census of population of Ireland, 1831: Comparative abstract, 1821 and 1831* (Parliamentary Papers, Vol. 39). London, UK: HMSO. Retrieved from <https://archive.org/details/op1245028-1001/>
- Great Britain. (1843). *Report of the commissioners appointed to take the census of Ireland for the year 1841* (Parliamentary Papers, Vol. 24). London, UK: HMSO. Retrieved from <https://archive.org/details/op1245957-1001/>
- Great Britain. (1856). *The census of Ireland for the year 1851, Part VI: General report* (Parliamentary Papers, Vol. 31). London, UK: HMSO. Retrieved from <https://archive.org/details/op1247883-1001>
- Great Britain. (1907). *Vice-regal commission on Irish railways, including light railways: Appendix to the first report* (Parliamentary Papers, Vol. 37). London, UK: HMSO. Retrieved from <https://archive.org/details/op1255211-1001>
- Gregory, I. N., & Cunningham, N. A. (2016). ‘The judgement of God on an indolent and unself-reliant people’?: The impact of the Great Irish Famine on Ireland's religious demography. *Journal of Historical Geography*, 51, 76–87.
- Hansen, G. D., & Prescott, E. C. (2002). Malthus to Solow. *American Economic Review*, 92, 1205–1217.
- Kelly, M., & Ó Gráda, C. (2012). The preventive check in medieval and preindustrial England. *Journal of Economic History*, 72, 1015–1035.
- Kelly, M., & Ó Gráda, C. (2014). Living standards and mortality since the Middle Ages. *Economic History Review*, 67, 358–381.
- Kelly, M., & Ó Gráda, C. (2015). Why Ireland starved after three decades: The Great Famine in cross-section reconsidered. *Irish Economic and Social History*, 42, 53–61.
- Lagerlöf, N.-P. (2015). Malthus in Sweden. *Scandinavian Journal of Economics*, 117, 1091–1133.

- Landes, D. S. (1999). *The wealth and poverty of nations: Why some are so rich and some so poor*. New York, NY: W. W. Norton & Company.
- Lee, J. (1976). The railways in the Irish economy. In L. M. Cullen & C. B. Daly (Eds.), *The formation of the Irish economy* (pp. 77–87). Cork, Ireland: Mercier Press.
- Lee, J. (1981). On the accuracy of pre-famine Irish censuses. In J. M. Goldstrom & L. A. Clarkson (Eds.), *Irish population, economy, and society* (pp. 37–56). Oxford, UK: Oxford University Press.
- Lee, R. D. (1981). Short-term variation: Vital rates, prices and weather. In E. A. Wrigley & R. S. Schofield (Eds.), *The population history of England, 1541–1871: A reconstruction* (pp. 356–401). London, UK: Edward Arnold Publishers.
- Lindeman, R. H., Merenda, P. F., & Gold, R. Z. (1980). *Introduction to bivariate and multivariate analysis*. Glenview, IL: Scott Foresman.
- McGregor, P. P. L. (1989). Demographic pressure and the Irish Famine: Malthus after Mokyr. *Land Economics*, 65, 228–238.
- Mitchell, B. R. (2013). F1 Asia: Length of railway line open (in kilometres). In B. R. Mitchell (Ed.), *International historical statistics* (pp. 1301–1312). London, UK: Palgrave Macmillan. [https://doi.org/10.1057/978-1-137-30568-8\\_442](https://doi.org/10.1057/978-1-137-30568-8_442)
- Mokyr, J. (1980). Malthusian models and Irish history. *Journal of Economic History*, 40, 159–166.
- Mokyr, J. (1985). *Why Ireland starved: A quantitative and analytical history of the Irish economy, 1800–1850*. London, UK: George Allen & Unwin Publishers.
- National Archives of Ireland. (2019). *Census of Ireland 1901/1911 and census fragments and substitutes, 1821–51. Census years: 1901* [Data set]. Retrieved from <http://census.nationalarchives.ie/pages/1901/>
- Nicolini, E. (2007). Was Malthus right? A VAR analysis of economic and demographic interactions in pre-industrial England. *European Review of Economic History*, 11, 99–121.
- O'Brien, G. (1921). *The economic history of Ireland between the union and the Famine*. London, UK: Longmans, Green.
- Ó Ciosáin, N. (1997). *Print and popular culture in Ireland, 1750–1850*. Basingstoke, UK: Macmillan Press.
- Ó Gráda, C. (1994). *Ireland: A new economic history 1780–1939*. Oxford, UK: Oxford University Press.
- Ó Gráda, C. (2013). School attendance and literacy in Ireland before the Famine: A simple baronial analysis. In G. FitzGerald (Ed.), *Irish primary education in the early nineteenth century: An analysis of the first and second reports of the commissioners of Irish Education Inquiry, 1825–6* (pp. 113–131). Dublin, Ireland: Royal Irish Academy.
- Ó Gráda, C., Paping, R., & Vanhaute, E. (2007). *When the potato failed: Causes and effects of the “last” European subsistence crisis, 1845–1850*. Turnhout, Belgium: Brepols Publishers.
- OpenStreetMap Ireland. (2020). *Irish townlands: Civil parishes data* [Data set]. Retrieved from [https://www.townlands.ie/static/downloads/civil\\_parishes.zip](https://www.townlands.ie/static/downloads/civil_parishes.zip)
- O'Rourke, K. (1994). The economic impact of the Famine in the short and long run. *American Economic Review: Papers & Proceedings*, 84, 309–313.
- O'Rourke, K. H. (1995). Emigration and living standards in Ireland since the Famine. *Journal of Population Economics*, 8, 407–421.
- Oxley, D. (2004). Living standards of women in pre-famine Ireland. *Social Science History*, 28, 271–295.
- Pfister, U., & Fertig, G. (2010). *The population history of Germany: Research strategy and preliminary results* (MPIDR Working Papers WP-2010-035). Rostock, Germany: Max Planck Institute for Demographic Research.
- Redding, S. J., & Sturm, D. M. (2008). The costs of remoteness: Evidence from German division and reunification. *American Economic Review*, 98, 1766–1797.
- Reis, J. (2005). Economic growth, human capital formation and consumption in western Europe before 1800. In R. C. Allen, T. Bengtsson, & M. Dribe (Eds.), *Living standards in the past: New perspectives on wellbeing in Asia and Europe* (pp. 195–225). Oxford, UK: Oxford University Press.
- Senior, N. W. (1868). *Journals, essays, and conversations relating to Ireland* (Vols. 1–2). London, UK: Longmans, Green.
- Solar, P. M. (1989). The Great Irish Famine was no ordinary subsistence crisis. In E. M. Crawford (Ed.), *Famine: The Irish experience 900–1900* (pp. 112–131). Edinburgh, Scotland: John Donald Publishers.
- Solar, P. M. (2015). Why Ireland starved and the big issues in pre-famine Irish economic history. *Irish Economic and Social History*, 42, 62–75.

- Solow, B. L. (1971). *The land question and the Irish economy 1870–1903*. Cambridge, MA: Harvard University Press.
- Tucker, G. S. L. (1970). Irish fertility ratios before the Famine. *Economic History Review*, 23, 267–284.
- Verpoorten, M. (2012). Leave none to claim the land: A Malthusian catastrophe in Rwanda. *Journal of Peace Research*, 49, 547–563.
- Weir, D. R. (1984). Life under pressure: France and England 1670–1870. *Journal of Economic History*, 44, 27–47.

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