Geography is not Destiny. Geography, Institutions and Literacy in England, 1837-1863

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Geography made rural society in the south-east of England unequal. Economies of scale in grain growing created a farmer elite and many landless laborers. In the pastoral north-west in contrast family farms dominated, with few hired laborers, and modest income disparities. Did this geography driven difference in social structure influence educational outcomes in England 1810-1845? Using new micro-level data we show this geographically-driven inequality is not a strong predictor of regional literacy rates. We conclude that regional literacy differences seem to have been influenced more by culture. In particular areas with more exposure to the highly literate Scottish society to the north seem to have acquired a higher demand for education, independent of local inequality. Geography is not destiny.

Introduction

This paper is a test of the thesis of Stanley Engerman and Kenneth Sokoloff—that geography is a key determinant of economic growth through the channels of inequality and institution formation.[2] Our testing ground is England which, despite its small area, has distinct regional climates and topography. This geographic diversity produced substantial differences in rural social structure. The south-east had large-scale grain agriculture with a few substantial farmers, and large numbers of landless labourers. The west and north had mainly dairy farming, small operating units, worked by many modest owner-occupiers.

[1] University of California, Davis
[2] Sokoloff and Engerman, 2012, which summarizes a series of papers including Engerman and Sokoloff, 1994 and 2002.

Did those differences in turn lead to differences in investment in education across England's regions that later explain the rapid growth of the north in the Industrial Revolution era, and the relative decline of the south?

For each of the 9,000 parishes of England we have measures of climate and topography. We also have, from the 1831 census, parish-level measures of social structure including the ratio of farmers to farm labourers, and from the 1851 census, measures of religious affiliation at the local level. Finally, we constructed measures of educational attainment for 100 parishes from archival records on the fraction of brides and grooms able to sign the marriage certificate, 1837-63. The marriage certificates also supply occupation information for all males involved.

We focus on parishes in two northern counties – Lancashire and Northumberland – and two southern counties – Essex and Somerset – with very different agricultural organisation. Using these we show that rural inequality predicts poorly average schooling attainment. Other cultural factors, independent of geography, dominate in explaining these variations. In doing this, the paper joins a growing part of the literature on inequality and institutions which argues that the consensus of Engerman-Sokoloff and others is not substantiated in within-country, micro-level samples.

Geography, Institutions, and Growth

The idea that geography can play a determining role in institutions and subsequent economic growth has a long history. In its modern form it is associated with a series of papers by Engerman and Sokoloff which argue for a chain of causation in New World growth that runs: **geography** determines **production scale** determines **inequality** determines **institutions** determines **human capital** determines **economic growth**.

In their argument the geography of the Caribbean and Latin America meant that these areas were best suited for crops such as sugar, cotton, coffee, or bananas, which were most efficiently produced on large-scale plantations. North America, in contrast, was best suited to production of grain and dairy products on small-scale

family farms. The economies of scale inherent in these farming systems produced societies that differed greatly in their degrees of inequality.[3]

In North America, with low inequality, there was high demand for education and a large political class in favor of public education. This in turn fostered high rates of literacy, and a population capable of high rates of innovation. In contrast, in the Caribbean and Latin America the political elite had little interest in public provision of education, since it did not serve their economic interests, and would undermine their political dominance. And the mass of unskilled workers was unable to afford education for their children through the private market.[4] Thus these societies remained unequal, uneducated, and ultimately poor in a world where human capital became the main engine of growth. This connection between rural inequality and investment in human capital has been modeled theoretically in Galor *et al* (2009).

They further argued that inequalities of political power and human capital witnessed in South and Central America caused the economic underdevelopment of these areas, as elites maintained growth-hampering institutions for their own gain and inequality stifled growth in either the stock of skilled labour or a sizable domestic market for new products. Proving or disproving this institutional channel has become a large cottage industry for scholars of economic history and development.

Another related literature is that on the channels through which the natural resource curse may work. It is hypothesized that abundance of natural resources may decrease the incentive to invest in human capital for individuals and for governments which may be controlled by rich elites who have no need to increase the skills of the work force. The evidence in this literature is mixed. Gylfason (2001) supports the hypothesis, but more recently Brunnschweiler (2008) and Stijns (2006) have produced cross-country evidence in refutation. In the context of this paper, we do not find that the south-east's advantage in terms of higher quality agricultural land translated into worse educational outcomes. Other factors dominated in the educational failure of the region relative to the north.

[3] Engerman and Sokoloff, 2012, 31-56.
[4] Sokoloff and Engerman, 2000, 229.

The Engerman-Sokoloff thesis, as a general view of development, has been empirically tested in a variety of ways with mixed results. Most commonly, a variable proxying for staple crops is included in standard growth regressions. Easterly and Levine (2003), for example, found countries suited to the cultivation of staples such as coffee and sugar experienced lower long run growth. More ambitiously, Easterly (2007) presents cross-country evidence supporting both aspects of the Engerman-Sokoloff thesis: that endowments determine inequality, and that inequality in turn determines growth.[5] However, Islam and Montenegro (2002) find that while inequality correlates negatively with institutional quality, this result seems to be driven solely by Latin America and Africa. Inclusion of indicator variables for these continents removes the result. Others have explored whether geography can explain the differential development of the south and north over US history, again with mixed results (Mitchener and McLean, 2003, Lagerlof, 2005, and Nunn, 2008).

However, even were such tests to show a correlation between geography, inequality, literacy, institutions and growth, a complication to the interpretation is that there are other pathways by which geography can influence inequality, literacy, and growth. Acemoglu, Robinson and Johnson (2001, 2002), for example, emphasize the role of settler mortality rates and prospects of European settlement in different climates and geographies as important determinants of the types of institutions established by European colonialists, and of subsequent economic performance. But settlement patterns could also directly influence economic performance, since different settlement groups, particularly those from Europe and Africa, came with very different cultural backgrounds. Guido Tabellini has argued that, at least within Europe, there is a long cultural legacy underlying modern populations that influences modern economic performance.[6] So for most of the cross country or even cross region tests of the Engerman-Sokoloff hypothesis there is a problem of multiple correlations between geography, institutions, inequality, literacy, and population origins.

A number of more recent studies that make use of within country, micro-level, data throw doubt on the consensus that inequality has long run implications for institutions and growth. Summerhill (2010) provides evidence from Sao Paulo to show that high levels of land inequality did not cause lower investment in education.

[5] Easterly instrumented with the ratio of land suitable for wheat production to that suited to producing sugar.
[6] Tabellini, 2010.

He finds instead that education provision was higher in areas that wished to attract more immigrants. It was a supply-side phenomenon. In fact in Sao Paulo, such immigrants often provided more education privately as well as pushing for greater public provision.[7] This kind of community provision was common during the period examined here in England. Similarly, Acemoglu *et al* (2007) find that for Columbian localities the land Gini coefficient was in fact positively related to long-run education outcomes including a measure of literacy identical to our approach here, the opposite of what has been predicted in the literature.

Galor *et al* (2009) conducted a similar test to that of this paper, using data from early twentieth century United States. They investigate whether geographic differences in public spending on secondary schooling across states can be explained by differences in geography and land inequality. They find that data from 1880-1920 supports these predictions.

Here we perform a similar test to these recent studies, asking whether geographically driven inequality can explain differences in literacy rates within England. In doing so, we are, similar to other studies in the economic growth literature, taking the general view of the Engerman-Sokoloff thesis seriously. But the advantage for this test is that the English are a much more homogenous population than many others that have been studied, thus eliminating much of the potential for geography to influence development through other channels.[8] Within such a setting can geographically driven inequality influence the development of educational institutions in important ways? Such institutions certainly played an important role in the Second Industrial Revolution and, even in the first, surely increased the population of malleable factory workers from which employers drew.

[7] For details of this, see de Carvalho Filho and Colistete, 2010.

[8] Cinnirella and Hornung, 2010, perform a similar exercise for Prussia, using nineteenth century land ownership concentration. However, Prussia was much more culturally and institutionally diverse than England, embracing German, Polish and Eastern Jewish populations whose concentrations correlated with the inequality measure used.

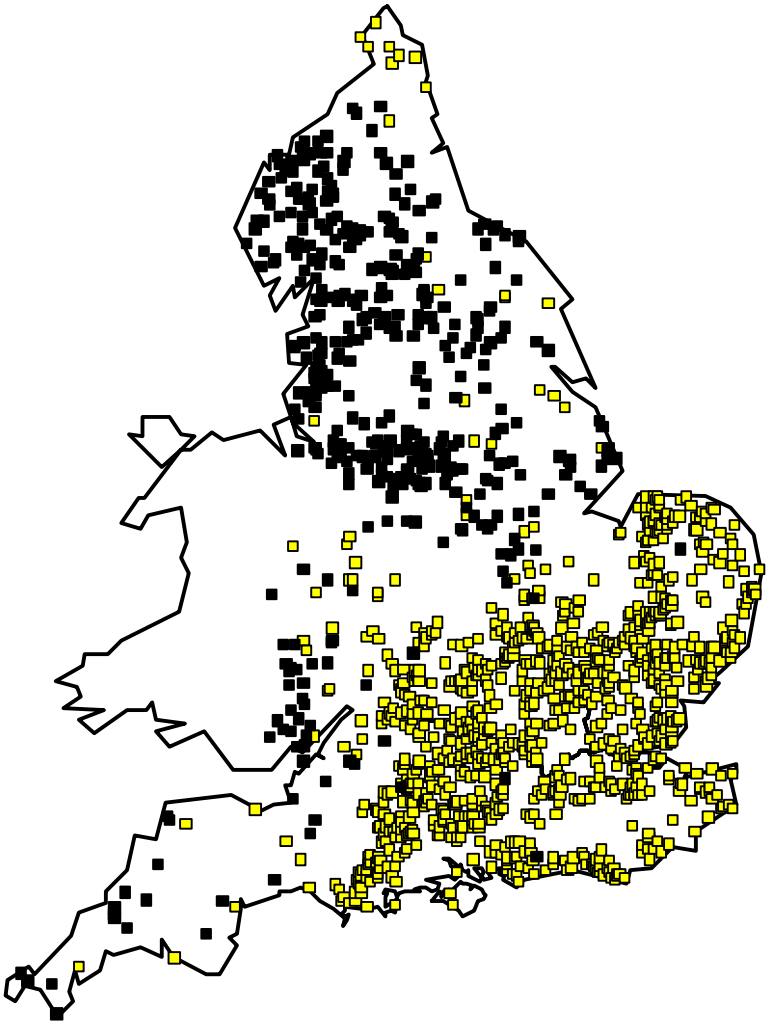
Geography and Rural Social Structure in Pre-industrial England

We measure social structure and inequality for rural English parishes using the ratio of male farmers to all men employed in farming in 1831. In Figure 1 the yellow squares show parishes and townships with fewer than 1 farmer per 10 male farm workers. The black squares show parishes and townships with more than 5 farmers per 10 adult males in farming.[9]

There was a marked difference in social structure across regions. In the south-east of England a large proportion of the population in rural areas comprised landless labourers, working for wages. In the north-west the majority of the rural adult male population comprised independent farmers, working for themselves. Even in the small compass of rural England there were differences in social structure that echoed those between pre-industrial North America and the Caribbean and Latin America.

[9] The figure is drawn for parishes or townships with 40 or more men employed in farming, and at least 30 percent of the male population engaged in farming.

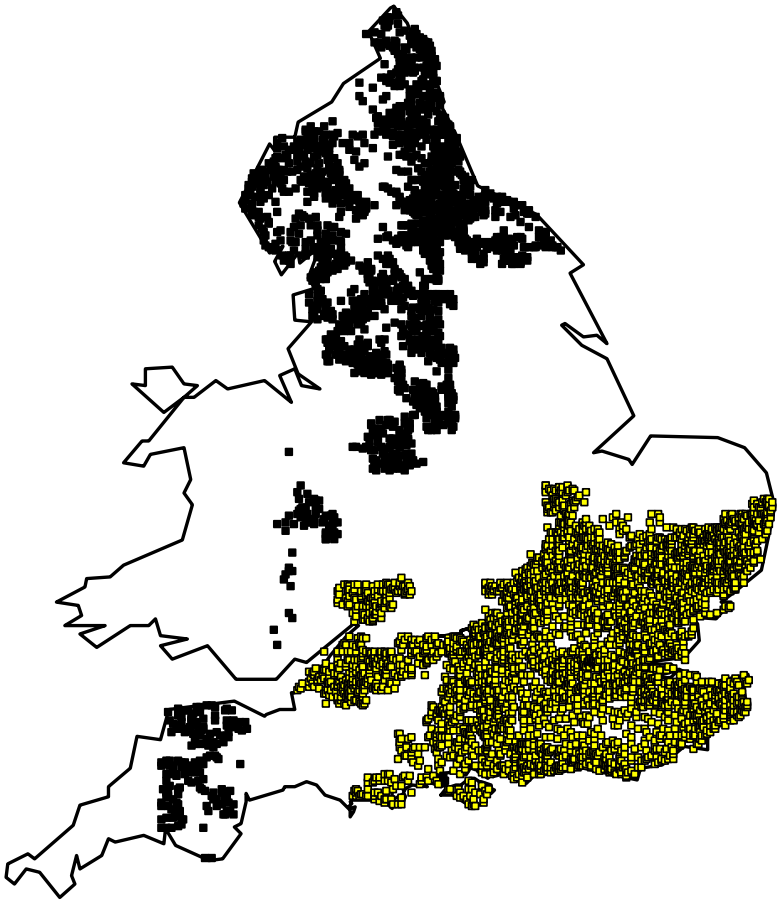
Figure 1: Social Structure in Rural England, 1831



Notes: In parishes shown as black squares at least half of the adult male population engaged in farming was listed as a farmer in 1831. In parishes shown as yellow squares the corresponding farmer share was less than 10 percent.

Source: British Parliamentary Papers, 1833. Ordnance Survey, Gazetteer of England and Wales (parish grid coordinates).

Figure 2: High and Low Degree Days above 10° C



Notes: Yellow = more than 800 degree-days above 10º C. Black = less than 675 degree days above 10º C.

Sources: Smith, 1976. Ordnance Survey, Gazetteer of England and Wales.

This difference in social structure can be largely attributed to geography, and in particular to climate and topography. Figure 2 shows one measure of climate and topographical differences across England. In yellow are shown parishes which had more than 800 degree-days above 10° C per year, a measure of potential crop growth.[10] In black are shown parishes with less than 675 degree-days above 10° C.

This simple climate difference clearly echoes the difference in rural social structure. Indeed if we regress parish FARMSHR (share of farmers among adult males in farming) on DEGDAY (degree days above 10° C) and DEGDAY2 (DEGDAY squared), the R^2 is 0.34.[11] One third of the variation in the numbers of farmers per person in farming can be explained by this one variable. Other climate and topographical variables correlate with organizational structure, as Table 1 shows: total rainfall, the growing season, and "days at capacity".[12] In the hotter, drier, flatter south-east grain production predominated, and in this there were significant economies of scale, so average farm sizes were large. In the wetter, cooler, hillier north and west dairy production was more profitable, with a smaller optimal farm scale. Family farms predominated with modest amounts of hired labour.

The climate variables in Table 1 all correlate with FARMSHR, because these measures are all highly correlated. Table 2 shows the correlation between the maximum elevation in England within 10 km grid squares, the yearly rainfall, the growing season, the degree days above 10° C, and the days when the soil is at moisture capacity. England is essentially composed of two farming zones: a lower, drier, warmer south-east and a higher, wetter, colder north-west, each with its associated optimal farming technology and organisation.

Regressing FARMSHR on all climate, topographical and soil variables increases the R^2 of the prediction of FARMSHR to 0.39.[13] At least some of the remaining

[10] Many plants do not grow unless the temperature exceeds a minimum, frequently taken as 10° C. The measure thus looks at the total days above this minimum times the amount the average temperature exceeded the minimum on each of these days. Crops such as wheat can only mature if this number exceeds a certain minimum.
[11] Weighting by the numbers engaged in farming in the parish.
[12] The length of the growing season is just the number of days where the average temperature exceeds 10° C. "Days at capacity" is a measure of the number of days each year when land cannot be ploughed since it is waterlogged. It is a measure of the suitability of land for arable cultivation.
[13] The regression estimates are shown in Appendix Table A1.

Table 1: Social Structure, Climate and Topography

Farmer share in all farm employment	**0.0-0.1**	**0.1-0.3**	**0.3-0.5**	**0.5+**
Parish Elevation (m)	79	84	107	156
Parish gradient (m)	160	207	318	425
Rain (in)	27	29	34	39
Growing season (days)	231	223	198	169
Degree-days above 10° C	795	762	691	630
Days soil at moisture capacity	146	158	191	224
Share of soil chalk	0.11	0.05	0.03	0.02
Share of soil gravel	0.10	0.08	0.06	0.06

Notes: Parishes or townships with 40 or more adult men employed in farming in 1831, and at least 30 percent of adult men engaged in farming.
Sources: Smith, 1976. Clark, 1998. British Parliamentary Papers, 1833. Ordnance Survey, Gazetteer of England and Wales.

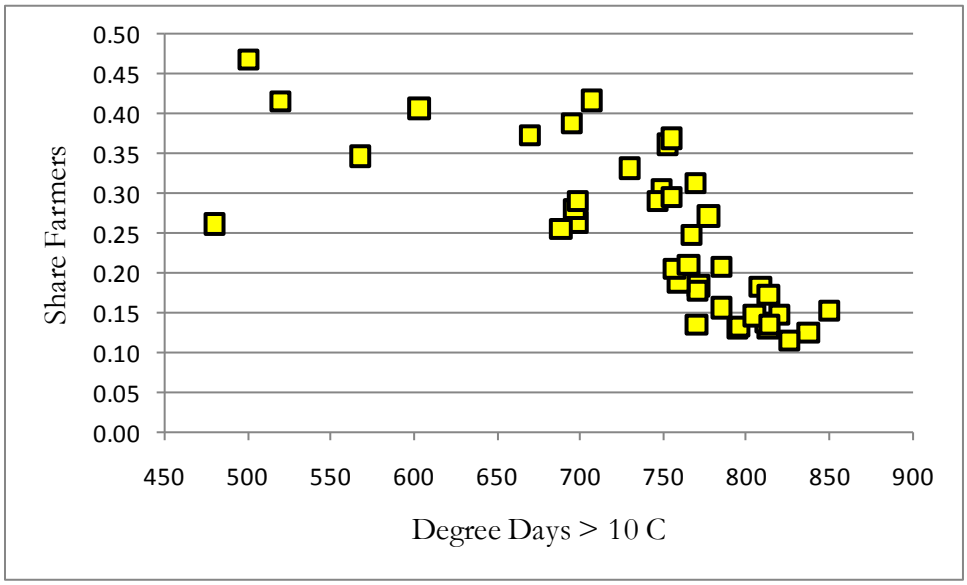
variation is random error. If, for example, the estimation is done only for parishes with 150 or more farm workers then the R^2 rises to 0.45. If the data is aggregated to the level of the 42 counties in England, the R^2 from regressing FARMSHR on DEGDAY and DEGDAY2 becomes 0.68. Adding more geographic variables at the county level can bring the R^2 above 0.80, though the adjusted R^2 is then only 0.73. Figure 3 shows the connection between FARMSHR and DEGDAY at the county level.

Table 2: Correlations between Climate and Topography

	Maximum Elevation	Rain	Growing Season	Degree-Days	Days at Capacity
Maximum elevation (m.)	1.00				
Rain (in.)	0.78	1.00			
Growing Season (days)	-0.90	-0.78	1.00		
Degree-Days above 10° C	-0.80	-0.60	0.84	1.00	
Days at Soil Capacity	0.87	0.94	-0.90	-0.74	1.00

Source: Smith, 1976.

Figure 3: Degree-Days above 10° C and the Share of Farmers, by County



Source: Parliamentary Papers, 1833. Smith, 1976. Ordnance Survey, Gazetteer of England and Wales for parish locations.

Social Structure and Rural Education

Social structure could affect literacy in two ways: through both demand for, and supply of, education. With a higher proportion of the population engaged in occupations where literacy had an economic value, as in the north-west, we would expect more demand for education and more literacy. If this was the only effect of social structure then once we control for father's occupation, there would be no further effect on literacy. In particular, labourers' children would be no more likely to be educated in the north-west than the south-east. This is the channel that Cinnerella and Hornung (2010) argue for nineteenth century Prussia—they do not include variables to measure occupational composition so we cannot tell whether there is any effect beyond the simple demand-side story.

Social structure could also affect education supply through at least three channels. First, if there are scale economies in schooling, greater demand will induce a lower cost supply of private education, so that a social structure with more farmers would also drive down the cost of education for labourers. In this case a labourer in the north-west would be more likely to be literate than a labourer in the south-east.

Secondly it has been argued that local citizens may tax themselves to supply subsidised public education if more of them have political voice, as they would as farmers, as opposed to the voiceless landless labourers (Go and Lindert, 2010). Thus, Go and Lindert credit the high level of northern US educational attainment before 1850 to local communities voting to tax themselves to subsidise schools. In England before 1870, however, this mechanism of support for local schools was blocked by law. Local endowments, subscriptions and bequests were the only funding for schools.[14]

But in modest sized rural communities those with property, who collectively ran the parish governments, could reach agreements to contribute voluntarily to subsidising local schools. In his study of rural education in the East Riding of Yorkshire, Bamford described how "the birth, composition and welfare of most schools was usually a joint effort, involving the churches, the lord of the manor and other local celebrities, together with endowments and subscriptions."[15]

[14] Mitch, 1992, 115.
[15] Bamford, 1965, 10.

Thus the differences in social structure across England could have an effect through this third supply mechanism, the willingness of the local propertied to combine voluntarily to subsidise local education. If these contributions would mainly serve to subsidise the education of the children of the contributing group, such support would be easier to arrange. But in the south-east, where there were a few large employers per parish, landlords and farmers should have been indifferent to education, which had no value in the agriculture of the time, and would have no economic incentive to band together to offer subsidies for local charity schools. They would want to secure education for their own children. But there would be too few of them in any parish to provide proper public education.

W. K. Jordan's study of rural parishes, analyzing the extent of philanthropy across English regions 1480-1660, provides evidence in support of this channel. He describes how, in a large county like Yorkshire, the development of an institution such as schooling varied a lot across parishes, because it was dependent on the prosperity and generosity of local large landowners or the success of groups of smaller, lower status people, yeomen and husbandmen, in clubbing together to fund a school.[16] Other examples include the north-west parish of Hyde which created a local school in the 1770s through public subscription and the parish of Ashton where parishioners in 1721 were able to fund the rebuilding of a local school.[17]

Education Measures

We use literacy, the ability of grooms and brides to sign the marriage register at their wedding, for the years 1837-1863, as a proxy for educational institutions at the parish level. After 1837, a uniform system of marriage registration was implemented. Each certificate was signed or marked by the bride and groom. We record the ability to sign along with other relevant details including age, parish of residence at time of marriage as well as occupation and father's occupation. The data was newly collected for this project and represents a significant addition to the stock of available knowledge on English nineteenth-century parishes and rural literacy. The measure used proxies for educational institutions for the years 1810-1845, when these brides and grooms were of school-going age. There are other examples in the

[16] Jordan, 1962, 402-3.
[17] Harrop, 1983, 41.

economics literature of literacy being used to proxy for educational attainment—the Engerman-Sokoloff series, Acemoglu *et al* (2007), Tabellini (2010). Furthermore, Romer (1990) showed that literacy had some indirect effect on growth rates across countries and that this effect was almost identical when using direct measures of educational attainment instead. In the empirical analysis, we control for fathers' occupation, thus partialling out the variation in literacy rates that might be due to family influence, wealth or attitudes to education.

This data source has been widely used to study literacy and its advantages and shortcomings have been much discussed. The marriage registers cover the entire married population, and 88 percent would get married.[18] Anderson has shown that the rates of civil marriage were similar across England in 1844-64.[19] Signature data also has the advantage of being comparable across time and space.

Potential flaws include the possibility that literacy and marriage were positively correlated, which would bias our measure upwards, and the likelihood that, since reading was taught first in schools, some of those who could not sign their name were in fact partially literate, which would mean that our measure is biased downwards. But, as long as the magnitude of these biases stayed constant over time and place, they will not affect the tests performed below. Most serious perhaps is the claim that ability to sign one's name did not imply an ability to write more generally. But educational manuals from the eighteenth and nineteenth centuries suggest that, unlike today, the first thing that a student learned to write was probably not their name, but some religious words and phrases. Again, since we are concerned with relative literacy levels across England, what exactly signing implied for overall levels of education is not of concern here.

To examine the effects of local social structure on literacy we use 8,105 individual records of literacy from 100 parishes/townships in four counties. The counties are Essex, with the second highest ratio of labourers to farmers in England, Lancashire with one of the lowest ratios, and Northumberland and Somerset, which both have intermediate ratios. Figure 4 shows the location of the parishes in the

[18] Schofield, 1968, 320, estimates that the proportion never marrying in 1851 was 11 percent for men and 12 percent for women.
[19] Anderson, 1975, 55.

Figure 4: Parishes in the Four County Sample

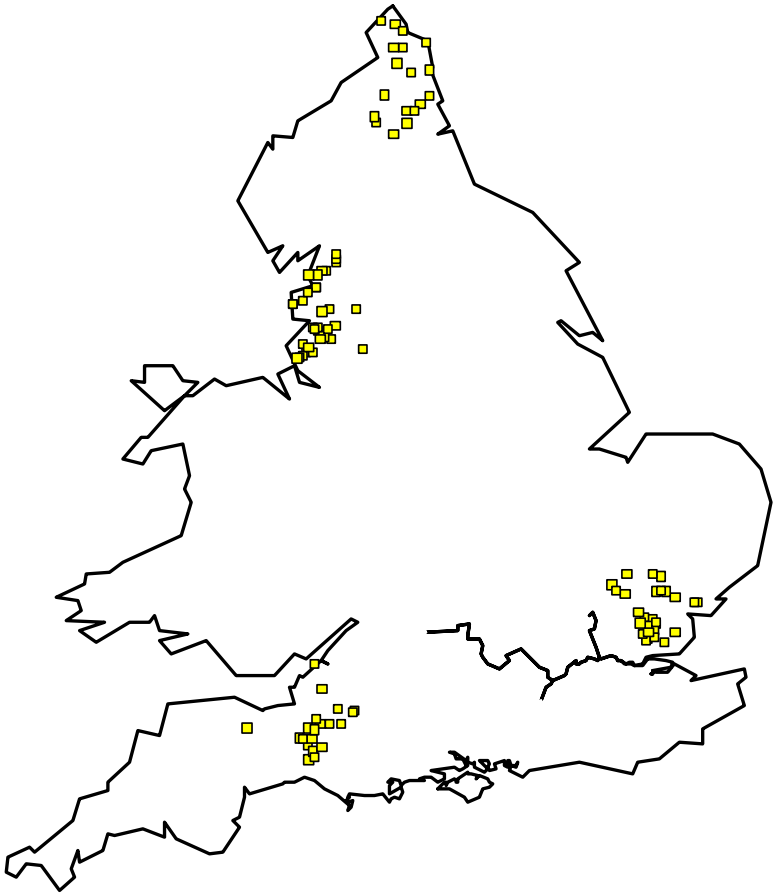


Table 3: Literacy Sample, 1837-63, Summary Statistics

	Essex	Northumberland	Somerset	Lancashire
Share farmers	0.13	0.24	0.32	0.38
Parishes/Townships	27	18	18	37
Grooms	1,325	468	951	1,000
Brides	1,423	703	987	1,166
% from sample parishes	93	83	98	87
Literacy Rate, Grooms	0.43	0.93	0.55	0.66
Literacy Rate, Brides	0.50	0.84	0.48	0.44
Average Age, Grooms	26	28	26	27
Average Age, Brides	23	25	24	24
Father's Occupation (%)				
Gentleman	1	3	2	1
Professional	3	6	2	3
Farmer	7	20	18	39
Trader	5	5	5	4
Craftsman	15	21	18	19
Skilled labourer	6	25	5	9
Unskilled labourer	64	20	51	26
Sample Size	2,748	1,361	1,937	2,061

Notes: Essex average ages are based on a subsample of the total observations, because often individuals simply reported whether they were of full age or not, so these average ages are biased upwards.
Sources: Marriage Certificates.

sample. The main constraint in generating a large sample was identifying parishes that were largely rural, to facilitate a fair test of the Engerman-Sokoloff channels.

Table 3 displays summary statistics. There are more brides than grooms because grooms were more likely to come from a parish outside the sample. Such observations were omitted to maximize the chances that individuals grew up in the parish where we observe the marriage. In terms of representativeness of the sample, we note that there are higher proportions of women in our sample compared to the national average, and that the average age at marriage is slightly higher than that present in the Cambridge group sample of 26 parishes, which is generally accepted as representative of the English population. Specifically, the 1831 Census showed that 51% of English inhabitants were female.[20] The figures for our sample parishes in Essex, Lancashire, Somerset and Northumberland respectively are: 52%, 54%, 51%, and 60%. The Cambridge group age at first marriage for their sample was given as 23 for women and 25 for men, for the years 1830-1837.[21] Our sample is close for women but men are usually older for the marriages we observe. This is partly driven by the fact that we observe all marriages, not just first marriages. However, these summary statistics are reassuringly close to these other representative samples. In terms of occupational distribution, by definition our samples are not representative of the entire country because we focus on rural areas that have experienced the least economic change and therefore where endowments should matter most.

It is apparent in Table 3 that there were substantial differences in literacy rates across counties. But there were also surprising differences in relative literacy rates for men and women. Northumberland had the highest rates of both male and female literacy. Lancashire, however, while having high rates of male literacy, had the lowest rates for female literacy. Essex, with the lowest male literacy rates, had substantially higher female literacy rates. There were also substantial occupational differences across parishes, principally in the shares of farmers versus labourers.

Table 4 displays summary statistics for the geographic and agricultural structure variables that will be used in the regressions, for the sample parishes. This can be compared to Table 1, which summarised all of England's agricultural parishes. We

[20] Wrigley *et al,* 1997, Table 3.2, 46-7.
[21] Wrigley *et al*, 1997, Table 5.3, 134.

Table 4: Representativeness of our Sample

	Essex	North'land	Somerset	Lancs.
Share farmers	.13	.24	.32	.38
Share farmers, range	.04-.31	.03-.73	.10-.69	.07-.76
Elevation (m)	44	172	103	99
Rain (in)	23	34	34	42
Growing season (days)	257	148	212	168
Degree-days above 10C	837	469	774	669
Days soil at capacity	109	223	182	234
Share chalk	.01	.01	0	.01
Share gravel	.07	.03	.07	.04

Sources: Smith, 1976 (Elevation, Rain, Growing Season, Degree-days, Soil at Capacity), Clark, 1998 (Share Chalk, Share Gravel). British Parliamentary Papers, 1833 (share farmers). Ordnance Survey, Gazetteer of England and Wales (parish locations).

do not expect these tables to be identical, because our sample contains rural parishes, but we find that they are reassuringly close and that there is substantial variation in geography and social structure. This is highlighted particularly in the third row, which displays the range within counties for the share of farmers within agricultural workers—there will be plenty of variation to estimate its effect on literacy, even using county fixed effects.

One final potential data issue is that migration may have caused selection bias in the literacy data we have collected. Movers may have different characteristics from stayers. For this period, it is difficult to obtain information on migration rates and characteristics across England. Pooley and Turnbull (2003) present information on migration from 16,091 life histories completed by family historians. They show that,

1750-1839, the average move was only 38km and most moves occurred within region, and were across settlements of similar size.[22] Thus, in rural England a high proportion of moves were to other rural areas. This appears to be true for the counties analyzed here. For 1750-1879, 76% of all migration within the North and Northwest was classified as within region, as was 67% of migration in the East, and 69% in the Southwest.[23] Similarly, Williamson (1990, 20-21) shows that emigration rates from the rural South and rural North of England were similar for the decade 1841-1851 (they were both between 500 and 600 per 1000). Thus, to the best of our knowledge, the patterns were quite similar across our sample regions. We are confident that differential rates of migration will not drive the results. Also individuals appear to have migrated to other similar rural areas for the most part. For example Clark (1987) showed that 55% of migrants in a small early modern Norfolk sample migrated from a wood-pasture parish to a wood-pasture parish.[24] It should thus be the case that net migration from our parishes has little effect on our measurement of literacy at the parish level.

Related to this issue is the question of how reasonable is our assumption that individuals grew up in the parish in which they get married. Pooley and Turnbull (2003) are useful again here. They explain that couples, or at least one member of a couple, often migrated after marriage, and that a small proportion of migrations occurred before marriage. For the period 1820-1849, they estimate that 33% of male migrants moved while single, and 25% of female migrants. Given that some proportion of these would never marry, this gives us an upper bound for the potential mismeasurement in the literacy variable.[25] Kitch (1992), looking at Sussex from the late 1500s to the early 1900s, suggested that only 25-40% of marriages crossed parish boundaries and that it was more likely for higher class individuals to seek a marriage partner outside of their home parish. The mean distance travelled by marriage partners was 4.7km. Given that our geography data applies to a slightly broader geographic area than parishes, this radius should be in line with the right hand side variables.

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[22] Pooley and Turnbull, 2003, 65, 104-5. In fact, 1750-1839, over 76% of moves were either within region or to a new settlement of the same size.
[23] Pooley and Turnbull, 2003, 81.
[24] Clark, 1987, 233.
[25] Pooley and Turnbull, 2003, 207-213.

Finally, our variable choice is in line with those used in research on the Engerman-Sokoloff hypothesis and should not suffer from greater attenuation bias than those studies.

Empirical Analysis

Does the employment structure explain differences in literacy rates across parishes? To test whether differences in demand and supply created by geography had effects on literacy we estimate the coefficients in a set of logit regressions, because the dependent variable is dichotomous.[26] The first is

$$DLIT = a + b_0 FAGR + b_1(YEAR - 1837) + b_2 FARMSHR + e \qquad (1)$$

which we estimate for grooms and brides together from parishes where at least half of men were employed in farming in 1831. DLIT is an indicator variable, which takes a value of 1 if the individual is literate. FAGR is the share of adult men employed in agriculture in the home parish in 1831; YEAR the year of the wedding (1837-1863)[27] and FARMSHR is the share of men engaged in agriculture who were farmers in 1831.

Was literacy greater in rural parishes with a larger share of farmers both through the direct effect of employment types on education, and through the indirect effects from lower priced supply and community provision of education? Table 5 reports the regression estimates as the marginal effect on the probability of being literate of a change in each independent variable of one unit from their mean value.

As can be seen in column 1 the share of the agricultural labour force who were farmers has no significant effect on overall literacy rates in these parishes. Even had the estimated marginal coefficient been statistically significant, the structure of farm employment could explain little of the great range in literacy rates (17-96%) across parishes in the sample, since this variable changes by less than .75 over the sample

[26] The results are robust to using OLS. When the regressions are run using data aggregated to the parish level the conclusions are unchanged but the coefficients are less precisely estimated. Similarly with specifications including parish fixed effects.
[27] Using year dummies in place of the time trend yields the same results.

Table 5: Explaining Literacy Rates 1837-1863 (Logit estimates)

	(1)	(2)	(3)	(4)
FAGR	-.824**	-.523**	-.530**	-.370**
	(.150)	(.103)	(.098)	(.074)
FARMSHR	.053	-.166	.103	.074
	(.118)	(.104)	(.083)	(.088)
Year-1837	.007**	.007**	.007**	.007**
	(.001)	(.001)	(.001)	(.001)
Gentleman		.460**		.430**
		(.040)		(.035)
Professional		.319**		.270**
		(.046)		(.044)
Farmer		.282**		.264**
		(.039)		(.035)
Trader		.209**		.180**
		(.047)		(.045)
Craftsman		.159**		.123**
		(.038)		(.036)
Skilled labourer		.131**		.008
		(.044)		(.043)
Unskilled labourer		-.178**		-.178**
		(.036)		(.032)
Lancashire			.019	-.117**
			(.040)	(.039)
Northumberland			.372**	.262**
			(.032)	(.031)
Somerset			.004	-.040
			(.039)	(.032)
Observations	8,105	8,105	8,105	8,105
Pseudo-R^2	.03	.16	.09	.20

Notes: ** = significant at the 1 percent level, * = significant at the 5 percent level. Standard errors are in parentheses and were clustered at the parish level.

and the estimated coefficient is small at 0.053. In contrast, how rural a parish is, measured by the share of adult males engaged in farming, has a very powerful negative impact on literacy. Since this variable ranges from 0.5 to 1.0 for the sample of parishes used in the regression, this explains 40 percent of the variation in literacy.

The results are robust to using an alternative measure of inequality, the fraction of farms which are "small", meaning hire fewer than 10 labourers. The results also do not change when an indicator for female is included in the specifications in Table 5. Appendix Table A2 presents these results, which are consistent with the coefficients displayed in Table 5, and which still find no significant effect of FARMSHR on education. A third robustness check included parish-level wealth, proxied by the value of property in a parish in 1842, as a control. The main conclusions hold and we also find only small, positive effects of wealth on literacy. The full results are presented in Table A3.

The findings are puzzling given two facts. Higher status occupations by fathers implied higher literacy rates by brides and grooms (as we shall see below). And parishes with a higher FARMSHR had more people in higher status occupations, as is shown in Table 3. The explanation lies in the estimation reported in column 2. This shows the estimated coefficients from a regression where we estimate literacy, controlling for the occupation of fathers. Thus,

$$DLIT = a + b_0 FAGR + b_1(YEAR - 1837) + b_2 FARMSHR + \sum_i c_i OCC_i + e \quad (2)$$

where OCC_i is one of the seven occupational categories given in Table 3. This regression asks whether, controlling for your father's occupation, you were more likely to be literate in a parish with a larger farmer share.

As expected, fathers' occupations are powerful predictors of literacy. However, the coefficient on FARMSHR is larger but negative (though insignificant). Controlling for occupation, brides and grooms in parishes where a larger share of the farm labour force are farmers are more likely to be illiterate. This is what explains the failure to find any significant connection between the share of the rural population who were farmers and literacy rates. Seemingly where more men were farmers, farmers had lower status and literacy. And where more men were labourers, labourers had higher status and literacy.

In the third and fourth columns we repeat these estimates, controlling for differences at the county level in literacy rates. In these regressions the effect of FARMSHR on literacy is thus being estimated using only the variation across parishes within each county. Now, in columns 3 and 4, FARMSHR shows up as having a larger, but still insignificant, positive effect on literacy. Over the sample it might explain a 6-8 percent difference in parish literacy rates. But these effects are still dwarfed by the effect of ruralness (which produces differences of 19-26 percent in parish literacy rates), and by the county fixed effects (which explain as much as a 38 percent difference in literacy rates). The structure of the farming population, dictated by climate, can play only a modest role in determining literacy rates by parish. The vast bulk of the explanation for varying literacy rates comes from factors such as how rural parishes were and county fixed effects.

Figure 5 shows the relationship between the share of agricultural workers who were farmers and the literacy rate for 70 parishes with 30 or more observations, and at least half of men in 1831 employed in agriculture. The figure illustrates two things. The first is that there are clearly local variations in literacy rates, independent of variations in the structure of agriculture. Northumberland literacy rates were high (89 percent on average), whatever the share of agriculturalists who were farmers, and Essex rates low (45 percent on average). The second is that there is at best a weak connection between the employment structure in farming and the literacy rate.

As noted, the lack of connection between occupational structure and literacy implies that in rural parishes with a higher farmer share, literacy rates for farmers are lower. Table 6 tests this implication by looking at the determinants of literacy rates for the children of farmers, and for the children of labourers. If we do not include county fixed effects farmers' children are less literate in parishes where farmers are a larger share of the agricultural work force (column 1 of Table 6). With county fixed effects there is still a negative connection between FARMSHR and the literacy of farmers' children, but the effect is not statistically significant. The fixed effect that produces this result is that in the county with the largest share of farmers, Lancashire, farmers were 20 percent less literate. Going back to the baseline specifications in Table 5, if we include an interaction term between

Figure 5: Literacy by Parish versus Farmer Share among Agriculturalists

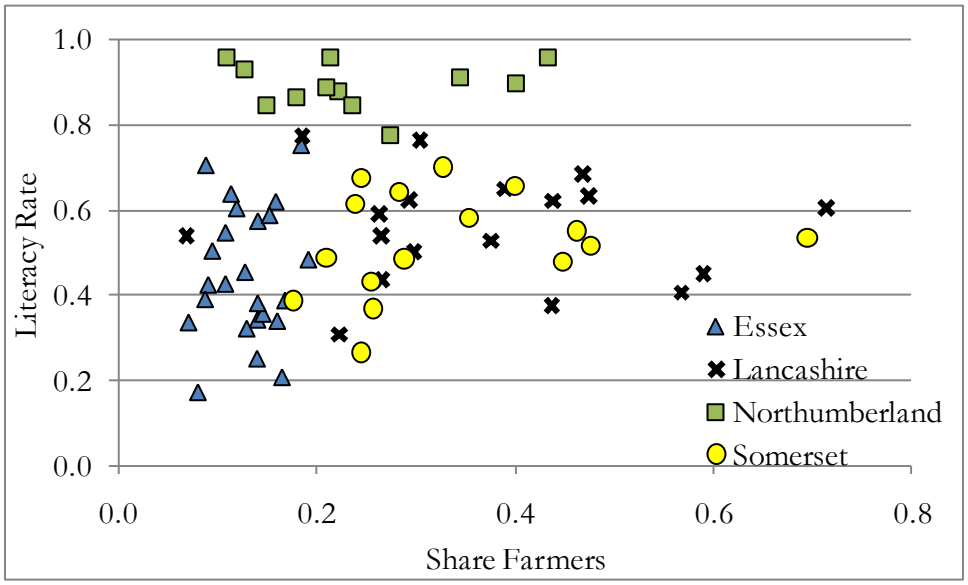
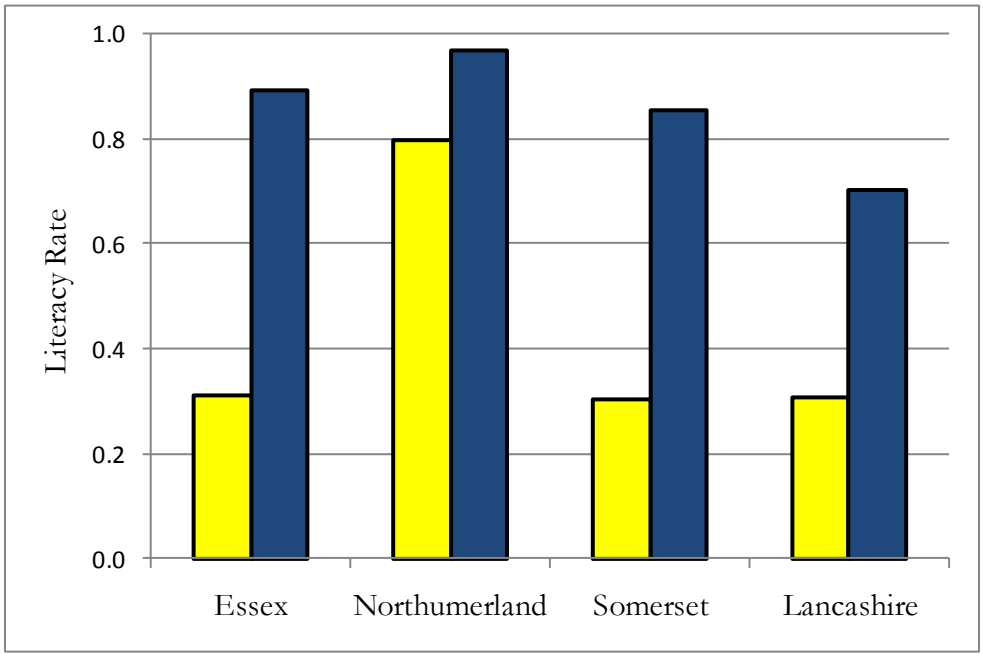


Table 6: Literacy Rates of Farmers and Labourers

Dependent Variable	Farmer	Farmer	Unskilled Labourer	Unskilled Labourer
(year-1837)	0.005*	0.005**	0.009**	0.009**
	(.002)	(.002)	(.001)	(.001)
FAGRIC	-0.292	-0.296*	-0.587**	-0.421**
	(.171)	(.140)	(.121)	(.095)
FARMSHR	-0.341*	-0.065	-0.003	0.109
	(.152)	(.116)	(.097)	(.092)
Lancashire	-	-0.189**	-	-0.052
		(.036)		(.044)
Northumberland	-	0.067**	-	0.450**
		(.027)		(.046)
Somerset	-	-0.033	-	-0.037
		(.032)		(.040)
N	1,616	1,616	3,584	3,584
Pseudo R^2	0.03	0.10	0.03	0.08

Figure 6: Literacy Rates of Unskilled Labourers and Farmers, by County



Notes: Dark bars represent the rate for farmers; light bars the rate for labourers.

FARMSHR and having a father who is a farmer, we see that there is a negative effect of a farmer father in parishes with larger proportions of farmers. This effect is about the same size as the advantage in general to being born to a farmer. The inclusion of this variable, which bears out our investigations in Figure 6 and Table 6, still does not change the implication that social structure has little effect on literacy.

For unskilled labourers there appears to be no connection between the share of the agricultural population that comprises farmers and their literacy rate, as shown in columns 4 and 5 of Table 6. But when we allow county fixed effects Northumberland stands out as having dramatically higher literacy rates for labourers. The analysis using unskilled labourers only also serves as a robustness check for our assumption that individuals were educated in the parish in which we observe them at marriage, because mobility was much lower among lower status individuals. There is therefore less chance of attenuation bias in these coefficients—it is thus reassuring that we still do not find evidence of a significant effect of inequality. This test also

highlights that there does not seem to be any spillover effect of farmer demand for education onto the lower status individuals. Were spillovers a large factor, then we would expect FARMSHR to influence labourer education positively, which we do not find. Similarly, the results are robust to including measures of parish population size and density and those variables are not significant, indicating that spillovers are not present.

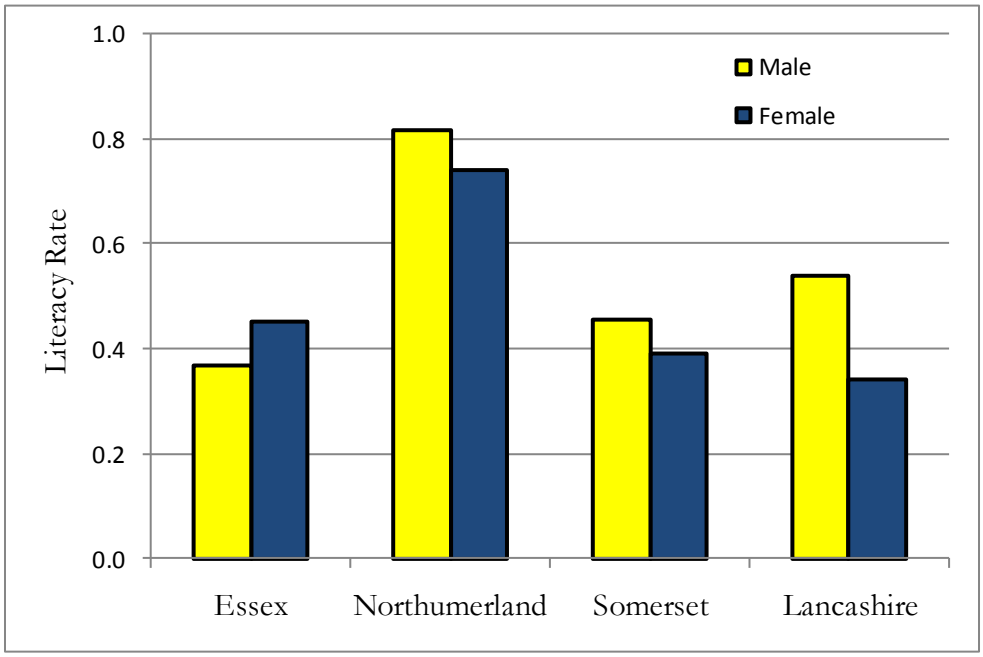
Figure 6 shows farmer and labourer literacy rates by county. Idiosyncratic variation across counties dominates any effect of the agricultural system.

The sense that idiosyncratic elements of local culture dominated in determining literacy, and not systematic elements from geography comes when we estimate separately male and female literacy rates by county, controlling for year, the fraction of the male population engaged in farming, and the share of those engaged in farming who were farmers. Figure 7 shows by county estimated male and female literacy rates. Female literacy rates relative to male rates vary widely. In Essex women were more literate than men, while in Lancashire they were substantially less literate. The argument that farm scale was the key determinant of literacy does not predict any county level variation in relative female literacy. Again orthogonal cultural forces appear important.

The only information the 1831 census gives on female employment are the numbers of female "servants." The ratio of female servants to the total population does vary substantially across parishes. Could it be that in areas of extensive employment of women in service, this raised the opportunity cost of female education and drove down literacy rates? This possibility is ruled out, however, by the finding that while Essex had the lowest rate of female employment in service, the rates of such employment were easily highest in Northumberland, which had an average level of difference between male and female literacy rates.

It could be that FARMSHR does not show a strong positive association with literacy because of reverse causation between literacy and FARMSHR. What would have to happen here is that high levels of literacy would themselves induce the creation of larger farms, through a move to more progressive farming structures and technologies which utilised economies of scale.

Figure 7: Literacy Rates for Men and Women by County



We can control for reverse causation by instrumenting for FARMSHR. Since FARMSHR correlates well with geography, as shown in Table 1, there is no shortage of potential instruments. However, for instruments to be valid they must not directly cause changes in literacy themselves. The structure must be

geography → FARMSHR → literacy

Table 7 shows the effects of FARMSHR when it is instrumented by all the geographic variables listed in Table 2. The F-statistics of the first stage in the estimation are satisfactory, above 10 in every specification. However, the reduced form for these regressions is presented in Appendix Table A4 and shows that the geographic variables are indeed jointly associated with literacy but that the relationship may be a weak one. This means that we cannot definitively say that there is no relationship between geography and social structure on the one hand and education on the other, given the bias that using weak instruments may introduce. The results, as discussed below, are consistent with our conclusion throughout the paper, that geographically-driven inequality is not the main determinant of literacy.

Table 7: Instrumental Variables Estimation

	(1)	(2)	(3)	(4)
Constant	1.075**	.975**	.634**	.593**
	(.128)	(.091)	(.160)	(.142)
FAGRIC	-.833**	-.581**	-.478**	-.323**
	(.149)	(.099)	(.153)	(.125)
Year-1837	.007**	.007**	.007**	.007**
	(.001)	(.001)	(.001)	(.001)
FARMSHR	.041	-.406**	.884	.743
	(.150)	(.139)	(.592)	(.559)
Gentleman		.442**		.388**
		(.046)		(.045)
Professional		.306**		.244**
		(.046)		(.044)
Farmer		.295**		.263**
		(.042)		(.033)
Trader		.200**		.194**
		(.050)		(.041)
Craftsman		.156**		.134**
		(.041)		(.034)
Skilled Labourer		.130**		.030
		(.048)		(.037)
Unskilled Labourer		-.187**		-.181**
		(.039)		(.028)
Lancashire			-.171	-.271
			(.154)	(.146)
Northumberland			.280**	.162**
			(.077)	(.075)
Somerset			-.152	-.172
			(.129)	(.121)
Obs	8,105	8,105	8,105	8,105
Pseudo-R^2	.04	.19	.08	.22
First Stage F-Stat	33	17	27	17

Notes: ** = significant at the 1 percent level, * = significant at the 5 percent level. Standard errors are in parentheses and were clustered at the parish level.

Without fixed effects for counties there is no greater effect of FARMSHR on literacy once it is instrumented, and indeed now a significant negative effect once we control for occupation. However, only once we include fixed effects for counties, which are all substantial, FARMSHR enters positively with very strong effects, but the standard errors quadruple so that nothing is even close to statistically significant (presumably because there is a strong association between geography and the county fixed effects). The county effects again seem much better at predicting the literacy variation than differences across parishes in geography.

Even if the IV estimates in columns 3 and 4 were significant, then it implies that within a relatively homogenous society such as England, differences in literacy rates created by factors other than geography will be dramatic, and geography will explain only a modest amount of the variation in literacy rates. To make this effect fit the data the IV estimation has to assign large negative fixed effects on the counties with large FARMSHR, Lancashire and Somerset. Furthermore, since what we really want to uncover is why Northumberland has higher literacy than Essex, the regression without fixed effects is the most relevant one to consider and, again, shows little evidence of a significant positive effect of land equality on education.

Interpretation

It is clear from the above that social structure derived from geography in early nineteenth century England played little role in explaining variations in literacy across rural parishes, unless we assume large countervailing exogenous differences across counties in underlying literacy rates. Could this be just because the institutional framework was one that prohibited parishes from taxing ratepayers to pay for schools, mechanisms that were available elsewhere such as in North America, and which were widely used? Could it be that social structure can only influence education when there is an ability to tax to supply subsidised public education?

A comparison of Northumberland with Berwickshire and Roxburghshire, the adjacent Scottish counties, suggests, however, that local taxing powers for education were in no way required for the achievement of high literacy levels. In Scotland, though schooling was not free, the 1696 education legislation required a publicly supported school in each parish, and provided for its support by a tax on

landowners. Scotland achieved high literacy rates by the eighteenth century, and this has been attributed to this mechanism of public support. Yet literacy rates in the Scottish lowlands, which includes these border counties, were little higher than in Northumberland by the early nineteenth century.[28]

The example of Northumberland shows that universal literacy was feasible even in an employment structure dominated by labourers, and where public provision of education through compulsory taxation was prohibited. There appears to have been a general culture in northern England that favored education, which Howkins describes as an "almost Scottish stress on the merits of democratic education".[29] This pro-education sentiment was also, crucially, shared by labourers in Northumberland and many children of labourers were educated at their parents' expense, often in private schools.[30] Houston's study of literacy and education in Scotland similarly draws many comparisons between lowland Scotland and the northern English counties and argues that they shared many "cultural patterns of which literacy was one".[31] Further evidence supporting the link to Scottish culture is found in a working paper by Cormac O'Grada (2010) which finds that, once the effects of economic structure and income are controlled for, Ulster stood out as having higher literacy rates than the rest of Ireland in 1841. The back and forth migration and long-standing connections of this region to Scotland are well-known and may have contributed to this effect.

Taking this argument further, we measured the correlations between literacy rates in Northumberland townships and their distance to Edinburgh. We also measured the correlation of literacy and the percentage of Scots born living in each township, revealed by the 1841 census.[32] Distance from Edinburgh was negatively associated with literacy, significant at the 5% level. The percentage of Scots born was positively associated, significant at the 10% level. These are simply correlations but they support a Scottish cultural influence in determining literacy rates. Figure 8 shows the relationship between literacy and percent of a township Scots born. Regressing literacy rates on this measure of "Scottishness" shows that a 1 percentage

[28] Stephens, 1990, 561.
[29] Howkins, 1991, 178.
[30] Stephens, 1987, 49-57.
[31] Houston, 2002, 257 and chapter 2.
[32] Using the website http://www.freemaptools.com/how-far-is-it-between.htm (3/7/2013).

point increase in the percent of a parish who was born in Scotland leads to a 1 percentage point increase in literacy rates.

Other compelling evidence against the geography hypothesis comes from looking at the earlier history of literacy in England. Geography was constant over time, and consequently even 200 years earlier, Essex already had few farmers and Lancashire many. There should thus already have been higher literacy in Lancashire than in Essex. But using signature data from the Protestation and Covenant Oaths of the 1640s, Cressy shows that Lancashire had only a 24 percent male literacy rate, while the rate in Essex was substantially higher at 37 percent.[33]

Religion and Literacy

We have argued above that culture must be responsible for differences in literacy rates across English regions. Was that cultural difference evidenced through religious affiliation? Since religious orientation can itself be heavily influenced by literacy and other cultural influences, we cannot show that religious affiliation determines literacy. But was it at least correlated with literacy? A recent study by Becker and Woessmann finds evidence of a causal link between Protestantism and literacy and education rates in nineteenth century Germany.[34] They use Prussian data to show that counties with proportionately more Protestants had higher school enrollment rates and more schools per inhabitant. This is true even after instrumenting for the Protestant share with distance to Wittenburg. This effect was particularly evident in the education of women.[35]

We have information on the religious composition of England's parishes from the 1851 census. This information identifies the share of the population affiliated with the established Church of England, with the Catholic Church, and with other Protestant denominations. We take as our measure of Protestantism the share affiliated with these other Protestant denominations, since the Church of England was an institution that, even though reformed from Catholicism, retained many aspects of Catholicism. Table 8 summarizes the data.

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[33] Cressy, 1980, 76-85.
[34] Becker and Woessmann, 2010.
[35] Becker and Woessmann, 2008.

Figure 8: Correlation Between Literacy and "Scottishness"

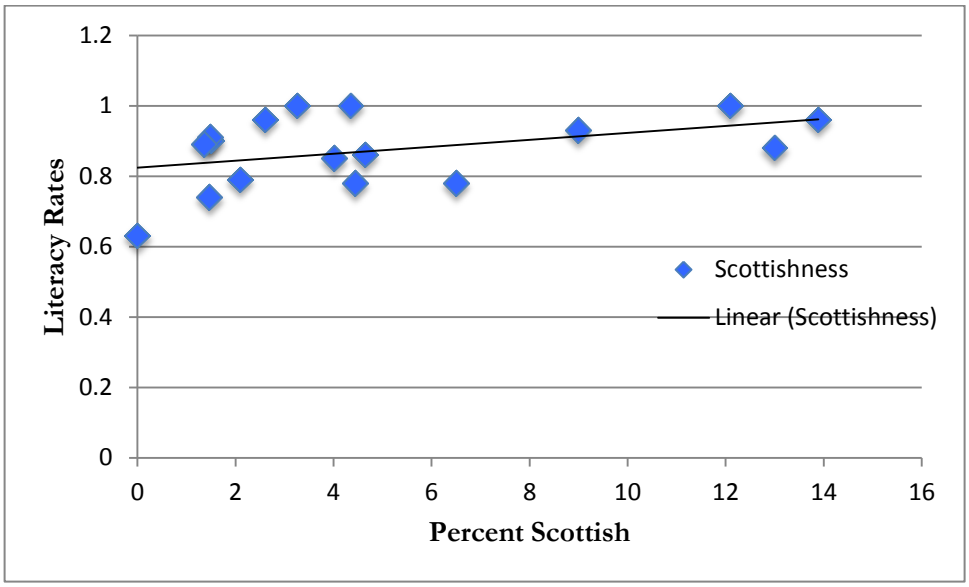

Table 8: Fraction Non-Conformist by County, 1851

Fraction Non-Conformist	Northumberland	Lancashire	Essex	Somerset
Average	.52	.29	.37	.39
Standard Deviation	.10	.01	.08	.06

Source: British Parliamentary Papers, 1852-3.

Table 9: Logit Regressions including Religious Composition

	(1)	(2)	(3)	(4)
FAGRIC	-.763**	-.479**	-.512**	-.356**
	(.145)	(.102)	(.103)	(.080)
FARMSHR	.176	-.060	.077	.054
	(.103)	(.095)	(.084)	(.090)
Year-1837	.008**	.008**	.008**	.007**
	(.001)	(.001)	(.001)	(.001)
Lancashire			-.003	-.133**
			(.042)	(.040)
Northumberland			.406**	.303**
			(.034)	(.036)
Somerset			.020	-.028
			(.043)	(.036)
Fraction non-conformist	.693**	.593**	-.347	-.312
	(.198)	(.169)	(.190)	(.166)
Occupation controls	No	Yes	No	Yes
Obs	7,927	7,927	7,927	7,927
Pseudo-R^2	.05	.16	.09	.20

Notes: ** = significant at the 1 percent level, * = significant at the 5 percent level. Standard errors are in parentheses and were clustered at the parish level.

Since the non-conformist share is high in the county with exceptional literacy rates, Northumberland, and similar in the three lower literacy counties, it seems promising that non-conformism will be correlated with literacy at the parish level.

Table 9 displays the results from logit regressions including a measure of the share of the population who was non-conformist.[36] The results show that the share non-conformist does significantly correlate with higher literacy rates, in line with the Becker-Woessmann findings. This result holds even when we control for the occupational status of parents.

But this result is not robust to the inclusion of county fixed effects, as is shown in the last two columns of the table. Once we control for county effects, so that the coefficient on the non-conformist share is estimated only on within-county variation, the estimated coefficient is now a substantial negative (though now these estimates are not statistically significantly different from 0). So there is actually little evidence that Protestantism *per se* is a driver of literacy rates, as opposed to Protestantism just being accidentally associated with the county with unusual high literacy rates. As Table 8 shows, however, there is little variation within counties at the parish level in non-conformism rates, so the failure to find any association may owe to this lack of variation.

Conclusions

A central component of the Engerman-Sokoloff hypothesis on the effects of geography on development is that pre-industrial agricultural systems which create greater inequality will reduce investments in education. For pre-industrial England we see that geography created great variations in social structure. We also see significant variations in the literacy rates of rural areas. However, social inequality was not an important driver of these variations. Thus while Cinnirella and Hornung (2010) find that in nineteenth century Prussia greater landownership inequality is associated with lower levels of primary schooling, large-scale farming has no connection with illiteracy in England. There is no law linking geography and

[36] We also ran the instrumental variables specification, including religion. The results were similar to those shown in the OLS table but are not reported here.

education. This is reinforced by the changing pattern of literacy in England 1640-1840, despite an unchanging geography and relative farm size composition.

However, while by exclusion the explanation of most of these literacy differences seems to be culture, we do not find evidence for the Becker-Woessmann conclusion that Protestantism was an important driver of literacy. Non-Conformism is positively correlated with literacy, but this correlation occurs only at the county level and not within counties. Protestantism may matter, indirectly, in that the source of the cultural difference that drove higher literacy rates in Northumberland may be the emulation of the high levels of education in the neighboring Scottish counties of Berwickshire and Roxburghshire. Those high levels of education can plausibly be attributed to the religious doctrines of the established Church in Scotland, which was Calvinist in inspiration.

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