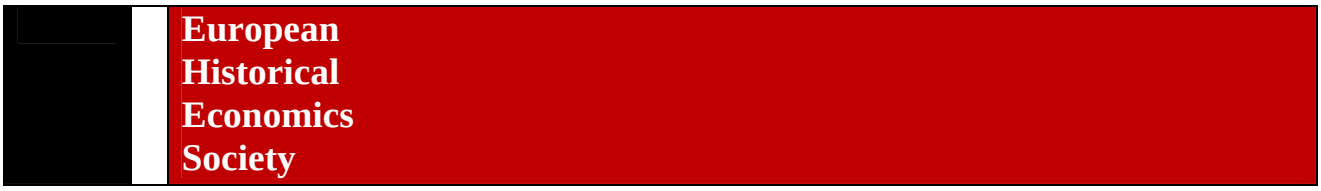

EHES WORKING PAPERS IN ECONOMIC HISTORY | NO. 15

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

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FEBRUARY 2012

EHES Working Paper | No. 15 | February 2012

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Abstract

Geography made rural society in the south-east of England unequal. Economies of scale in grain growing created a farmer elite and many landless labourers. In the pastoral north-west, in contrast, family farms dominated, with few hired labourers and modest income disparities. Engerman and Sokoloff (2012) argue that such differences in social structure between large plantations in the southern Americas, and family farming in the north, explain the rise of schooling in the north, and its absence in the south. We show, however, that rural literacy across England 1810-45 was not determined by geographically driven inequality. There were substantial differences in literacy by region, but driven by culture not geography. Geography is not destiny.

JEL codes: N93, N33, O15

Keywords: Comparative regional history, European education history, human capital development

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Gregory Clark* and Rowena Gray**

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Introduction

This paper conducts a test of the oft-cited thesis of Stanley Engerman and Ken Sokoloff—that geography is a key determinant of economic growth through the channels of inequality and institution formation.[1] Our testing ground is England which, despite its small area, has distinct regional climates and topography. The diversity in climate and topography produced substantial differences in rural social structure across pre-industrial England. The south-east had large scale grain agriculture with a few substantial farmers, and large numbers of landless day labourers. The west and north had mainly dairy farming, with small operating units, many modest owner-occupiers, and small numbers of landless labourers.

Did those differences in turn lead to differences in investment in education across the various regions of England 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 pre-industrial England we have measures of climate and topography, which are the ultimate determinants in the Engerman-Sokoloff story. We also have, from the 1831 census, measures of social structure such as the ratio of farmers to farm labourers by parish, and from the 1851 census measures of religious affiliation by local parish groupings. Finally, we can construct measures of recent educational attainment at the parish level from the fraction of brides and grooms who were able to sign the marriage certificate 1837-63. The marriage certificates also supply the occupations of the grooms, and of the fathers of both brides and grooms.

We focus on parishes in two counties in the north – Lancashire and Northumberland – and two counties in the south – Essex and Somerset – with very different agricultural organisation. Using these we show that rural inequality is actually a poor predictor of average schooling attainment. Other cultural factors, independent of geography, dominate in explaining these variations.

[1] Sokoloff and Engerman, 2012. This work summarizes a series of papers beginning with Engerman and Sokoloff, 1994.

Geography, Institutions, and Growth

The idea that geography and climate 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 Stanley Engerman and Kenneth 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 well suited for the production of 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 on small scale family farms of grain and dairy products. The economies of scale inherent in these farming systems produced societies that differed greatly in their degrees of inequality (Engerman and Sokoloff, 2012, 31-56).

In North America, with high degrees of equality 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. Conversely, 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 workers was unable to provide education to their children through the private market. Thus these societies remained unequal, uneducated, and ultimately poor in a world where human capital became the main source of growth. This connection between rural inequality and investment in human capital has been modeled theoretically in Galor, Moav, and Vollrath (2009).

Engerman and Sokoloff cited evidence on political participation as well as public education provision as key institutions whose character was shaped by the degree of inequality created by geography. They showed that the fraction of the population eligible to vote was consistently two or three times larger in North America than in other parts of the continent from the 1840s to the 1940s.[2]

[2] Engerman and Sokoloff, 2012, 24-5.

Further evidence was provided by literacy rates across the Americas, which show that North Americans were systematically and substantially more literate than South and Central Americans.[3] They argued that the inequality of political power and human capital witnessed in South and Central America caused the economic underdevelopment of these areas, as elites in these Southern regions maintained growth-hampering institutions for their own gain and because inequality stifled the emergence of a sizable domestic market for new goods as well as a larger supply of more skilled labour capable of producing such goods.

In the Engerman-Sokoloff view, inequality can drive economic growth, and that relationship persists over time because elites preserve their position by creating institutions more conducive to their profits than economic growth—high levels of inequality afford small groups of people political power to control institutions.

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 that countries suited to the cultivation of staples such as coffee and sugar experienced lower long run growth rates. 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.[4] 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 dummies 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, for example, emphasise the role of settler mortality rates and prospects of European settlement in different climates and

[3] Sokoloff and Engerman, 2000, 229.

[4] To control for endogeneity Easterly instrumented with the ratio of land suitable for wheat production to that suited to producing sugar.

geographies as important determinants of the types of institutions established by European colonialists, and of subsequent economic performance (Acemoglu, Robinson and Johnson, 2001, 2002). But settlement patterns could also directly influence economic performance, since different settlement groups, particularly those from Europe and Africa, come with very different cultural backgrounds. Guido Tabellini, for example, has argued that, at least within Europe, there is a long cultural legacy attached to modern populations that influences modern economic performance.[5] 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.

In an effort to disentangle these pathways, Galor, Moav and Vollrath (2009) conducted a similar test to that presented in 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 construct a model that assumes that human capital and land have little complementarity in production, which means that landowners have little interest in good educational institutions. Their data from 1880-1920 supports the model's predictions. However, within the US, there will still be correlations between geography and settlement patterns that are difficult to control for.

Here we perform a very similar test, 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 culturally homogenous population, thus eliminating much of the potential for geography to influence development through other channels.[6] 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.

[5] Tabellini, 2010.

[6] Cinnirella and Hornung (2010) perform a similar exercise for Prussia, but using nineteenth century land ownership concentration. However, Prussia was much more culturally 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

The measure we have of social structure and inequality for rural parishes in England in 1831 is the ratio of male farmers to all men employed in farming. 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 where there were more than 5 farmers per 10 adult males in farming.[7]

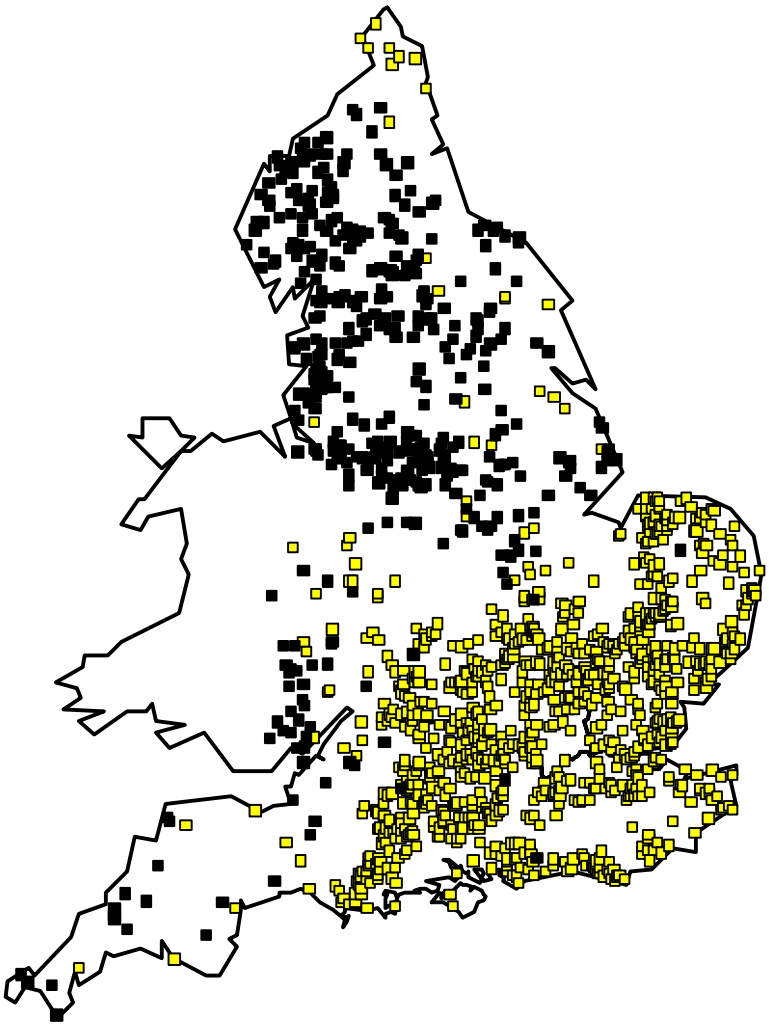
There is a marked difference in social structure across a small geographical area. In the south-east of England a large proportion of the population in rural areas comprised landless labourers, working for daily or weekly wages. In the north-west the majority of the rural adult male population comprised 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.

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.[8] 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 and township FARMSHR (share of farmers among adult males in farming) on DEGDAY (degree days above 10° C) and DEGDAY2 (DEGDAY squared), then the R^2 is 0.32. One third of the variation in the numbers

[7] 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.

[8] 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.

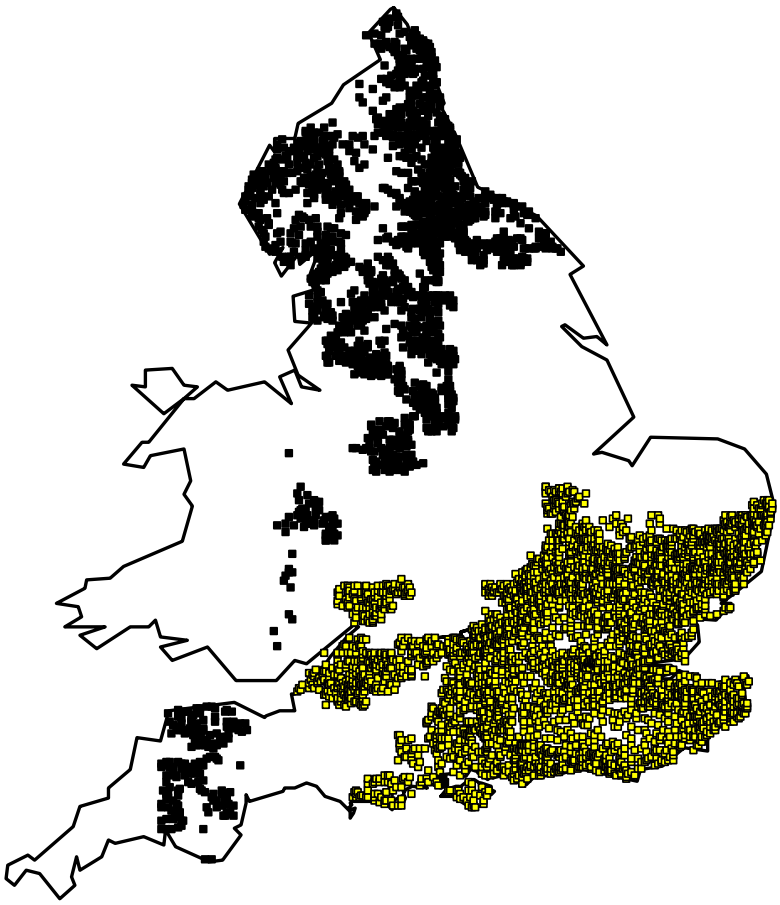
Figure 1: Social Structure in Rural England, 1831



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 10° C. Black = less than 675 degree days above 10° C.

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

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. British Parliamentary Papers, 1833. Ordnance Survey, Gazetteer of England and Wales.

of farmers per person in farming can be explained by this one simple variable. There are other climate and topographical variables that correlate with organizational structure, as Table 1 shows: total rainfall, the growing season, and "days at capacity".[9] 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, and here the optimal farm scale was much smaller. Family farms predominated with very modest amounts of hired male labour.

[9] 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.

Table 2: The 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 Capacity	0.87	0.94	-0.90	-0.74	1.00

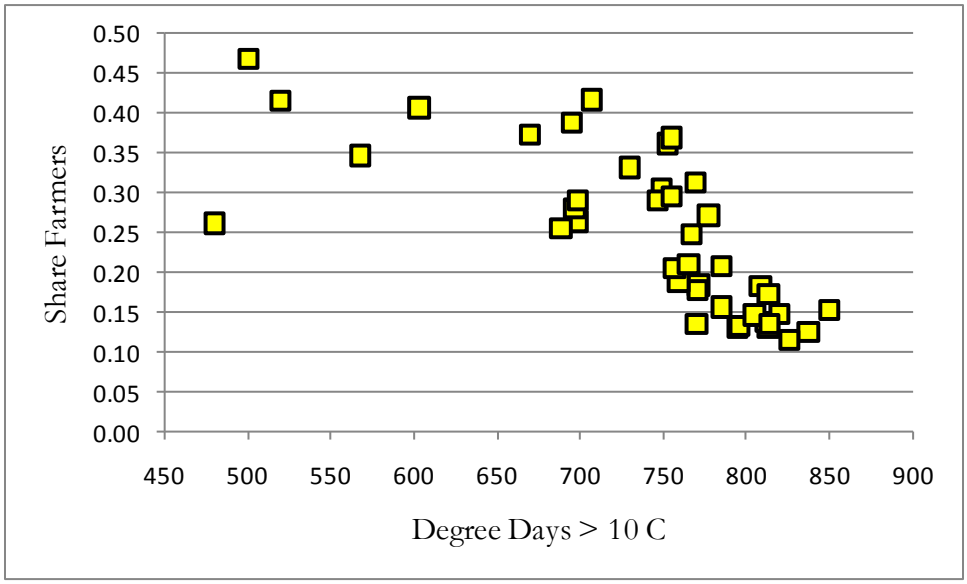
Source: Smith, 1976.

The climate and topography variables in Table 1 all correlate with the share engaged in agriculture who are farmers, because these measures are correlated among themselves. 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 west and north, each with its associated optimal farming technology and organisation.

Regressing FARMSHR on all these climate, topographical and soil variables increases the R^2 of the prediction of FARMSHR to 0.43[10]. At least some of the remaining 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 0.50. If the data is aggregated to the level of the 42 counties in England, then the R^2 from just regressing FARMSHR on DEGDAY and DEGDAY2 becomes 0.68. Adding more geographic variables 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.

[10] Full regression results are not shown here but are available from the authors upon request.

Figure 3: Degree-Days above 10° C and the share of Farmers



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

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.

But social structure could also affect the supply of education through at least three channels. First, as there are economies of scale in schooling, greater demand will induce a lower cost supply of private education, so that a social structure with more farmers would then drive down the cost of education also 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.[11]

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, T. W. 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."[12]

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 much of a market for local public education.

W. K. Jordan's study of rural parishes, analyzing the extent and nature 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 build and run a school.[13] Other examples can be found in the north-west parish of

[11] Mitch, 1992, 115.
[12] Bamford, 1965, 10.
[13] Jordan, 1962, 402-3.

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.[14]

Education Measures

The data that we have collected to measure educational attainment is a proxy for literacy, the ability of grooms and brides to sign the marriage register at their wedding, for the years 1837-1863. After 1837, a new uniform system of marriage registration was implemented. Each certificate was signed or marked by the bride and groom, as well as by at least two witnesses. 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. This measure proxies for educational institutions for roughly the years 1810-1845, when these brides and grooms were of school-going age. There are other examples in the economics literature of literacy being used to proxy for educational attainment—Tabellini (2010) does just that and, similarly, 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 also control for fathers' occupation, thus partialling out the variation in literacy rates that might be due to family influence or a tendency towards promoting literacy within the home.

This type of data has been widely used to study literacy and its advantages and shortcomings have been much discussed. The marriage registers cover the entire married population, except for Jews and Quakers (and the royal family). Those ever married constituted more than 88 percent of the population.[15] Anderson has shown that the rates of civil marriage were similar across England in 1844-64.[16] 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 literacy measure upwards, and the likelihood that, since reading was taught first in schools, some of those who could not sign their

[14] Harrop, 1983, 41.
[15] Roger Schofield estimates that the proportion never marrying in 1851 was 11 percent for men and 12 percent for women (Schofield, 1968, 320).
[16] Anderson, 1975, 55.

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 something that need concern us.

To examine the effects of local social structure on literacy we use 8,105 individual records of literacy by brides and grooms from 100 parishes/townships in four counties, chosen to represent different social structures and regions. The counties are Essex, with a high ratio of labourers to farmers, Lancashire with a low ratio, and Northumberland and Somerset, which both have intermediate ratios, one being in the south, the other (Northumberland) in the north.

Figure 4 shows the location of the parishes in the sample. The main constraints in generating a large sample were identifying parishes that were largely rural, to facilitate the most pure test of the Engerman-Sokoloff channels as possible. Furthermore, for Lancashire in particular, many records were in poor condition making it infeasible to use all potential parishes.

Table 3 displays summary statistics for this sample. There are more brides than grooms because grooms were more likely to come from a parish outside the sample county. The brides and grooms were assumed to be educated in their parish of origin as stated in the marital register. 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[17]. The figures for our sample parishes in Essex, Lancashire, Somerset and Northumberland respectively are: 52%; 54%; 51% and 60%. Our deviation from the national average is driven by the fact that some grooms have to be dropped because their reported home parish is not part of the

[17] Wrigley *et al,* 1997, Table 3.2, 46-7.

Figure 4: Parishes in the four county sample

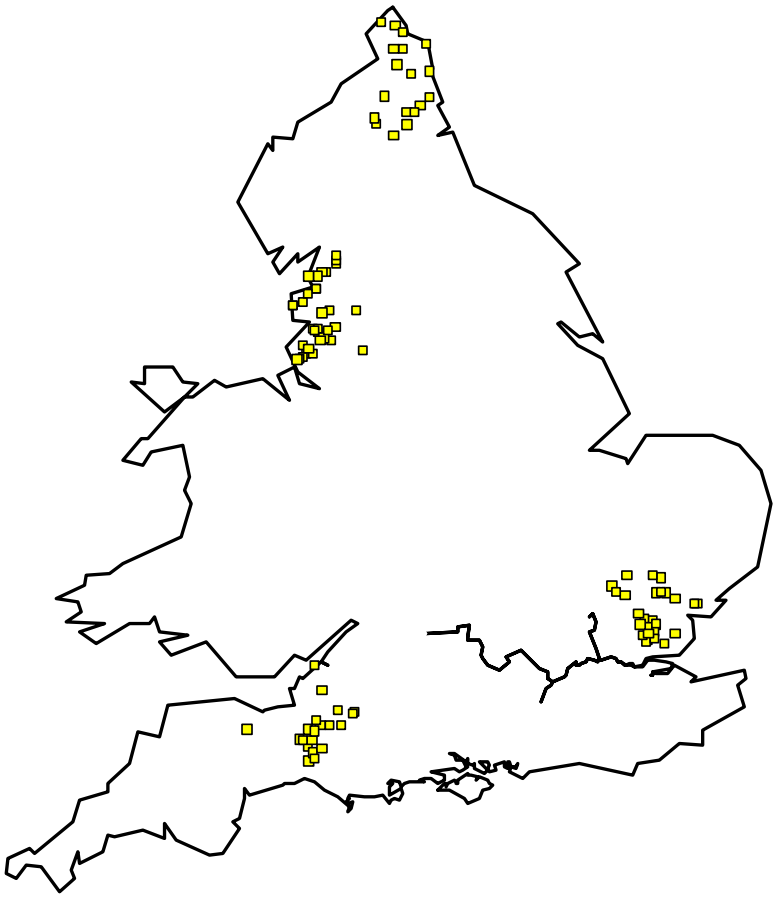


Table 3: Literacy Sample, 1837-63, Summary Statistics

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

sample, indicating that they lived in an urban or industrial area. 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[18]. Our sample is very close for women but the men are usually older for the marriages we observe. This is partly driven by the fact that we observe all marriages, not just first marriage, and so there are some widowers remarrying at older ages in the sample. However, these summary statistics are reassuringly close to 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 the most.

It is apparent in the table that there were substantial differences in literacy rates across these four 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 unskilled labourers.

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 migration characteristics across English parishes and counties. Pooley and Turnbull (2003), however, present information on migration from 16,091 life histories completed by family historians. They show that, 1750-1839, the average move was only 38 km and most moves occurred within region, and were across settlements of similar size[19]. 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.[20] Similarly, Williamson (1990, pp. 20-21) shows that emigration rates from the rural South and rural North

[18] Wrigley *et al*, 1997, Table 5.3, 134.
[19] Pooley and Turnbull, 2003, 65. In fact, 1750-1839, over 76% of moves were either within region or to a new settlement of the same size (pp. 104-5).
[20] Pooley and Turnbull, 2003, 81.

of England were very 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 can be fairly confident that differential rates of migration will not drive the results outlined below.

Empirical Analysis

Does the employment structure explain differences in literacy rates across parishes and counties? To test whether differences in demand and supply created by geography had effects on literacy we estimate the coefficients in a set of regressions, using logit regression since the dependent variable is dichotomous[21]. 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)[22] 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 4 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 of 0.053 been statistically significant, the structure of farm employment could explain little of the great range in literacy rates (17-96

[21] The results all go through if we use OLS—the OLS coefficients are very similar to the logit coefficients presented here and the overall explanatory power is slightly higher. If the regressions are run using data aggregated to the parish level, then the conclusions are unchanged but the coefficients are less precisely estimated.

[22] Using year dummies in place of the time trend yields no significant difference in the results.

Table 4: 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 presented in parentheses and were clustered at the parish level.

percent) across parishes in the sample, since this variable changes by less than .75 over the sample. 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 rates.

This finding is 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 where a larger share of the agricultural population were farmers.

As expected, fathers' occupations are powerful predictors of literacy. However, now the coefficient on FARMSHR is larger but negative (though not statistically significant). 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, but control 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 the most modest role in determining literacy rates at the parish level. The vast bulk of the explanation for varying literacy rates comes from factors such as how rural parishes were, as well as from county level effects on literacy rates.

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 brides and grooms observed, and at least half of men in 1831 employed in agriculture. The figure nicely 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 were farmers, and Essex rates were low (45 percent on average). The second is that there is at best a very weak connection between the employment structure in farming and the literacy rate.

As noted, the lack of connection between occupational structure and literacy rates has to imply that in rural areas with a larger share of the population farmers rather than labourers, the literacy rates for farmers must be relatively lower. Table 5 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 then farmers' children are significantly less literate in parishes where farmers are a larger share of the agricultural work force (column 1 of Table 5). With county fixed effects there is still an estimated 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 likely to be literate.

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 5. But when we allow county fixed effects Northumberland stands out as having dramatically higher literacy rates for labourers.

Figure 5: Literacy by Parish versus Farmer Share among Agriculturalists

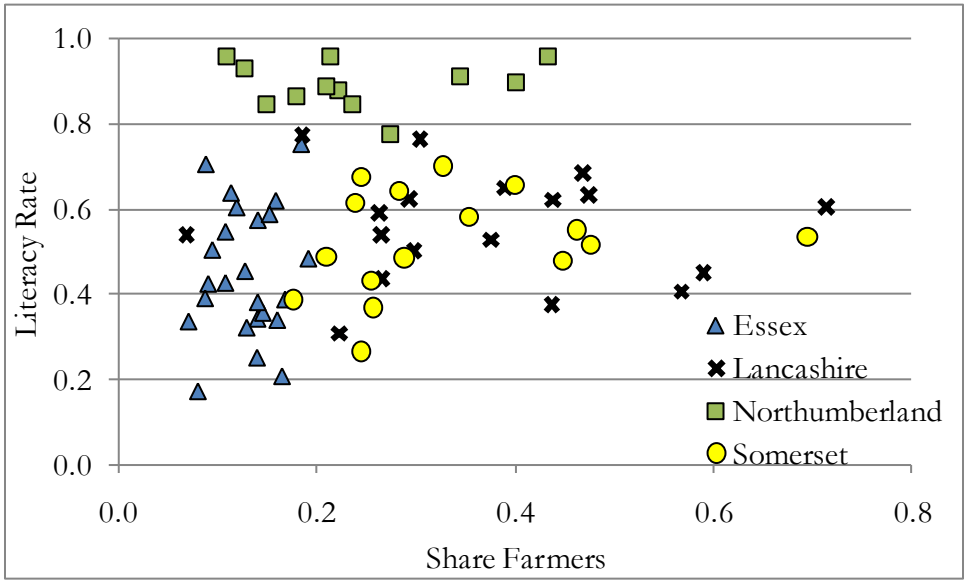
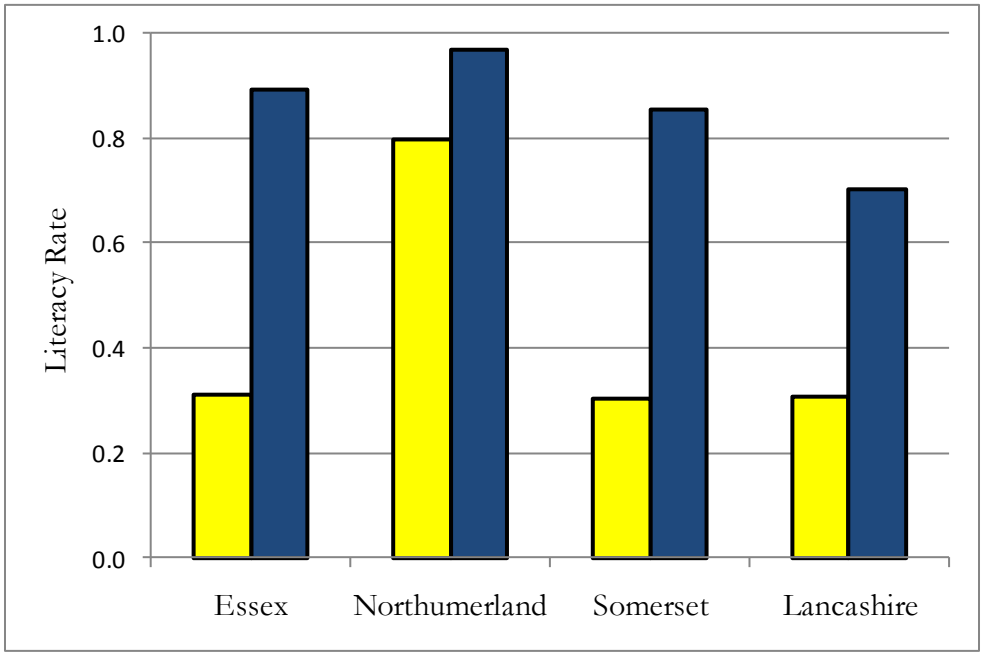


Table 5: Literacy Rates of Farmers and Labourers

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.

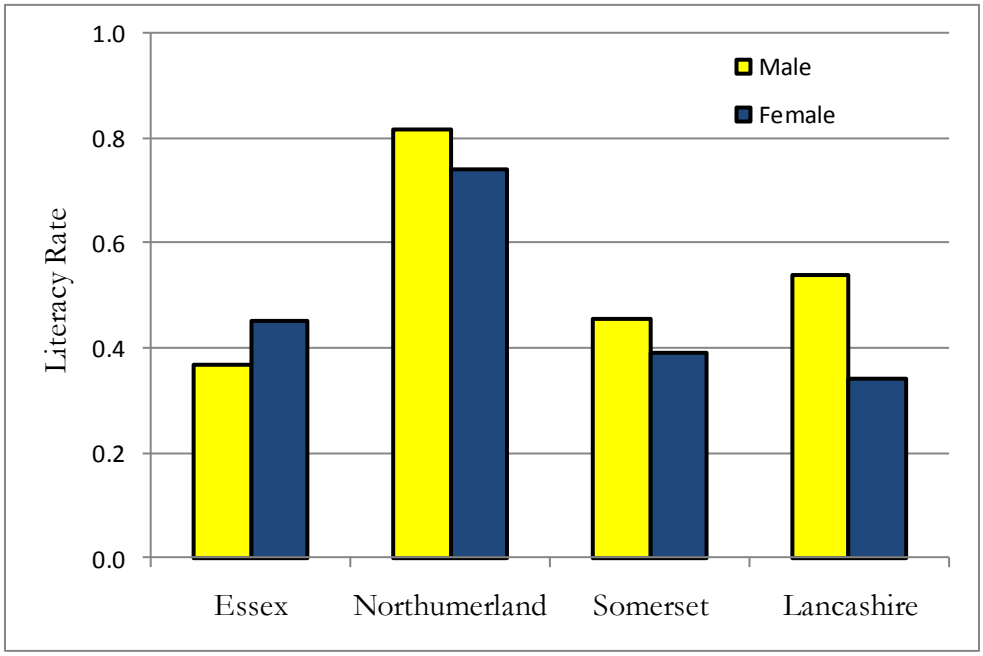


Notes: Dark bars represent the rate for farmers; light bars the rate for labourers.

Figure 6 shows by county the farmer and labourer literacy rates. As can be seen the 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.

Figure 7: Literacy Rates for Men and Women by County



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 did have 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.

There is one last possibility that we have to consider, and that is that FARMSHR does not show a strong positive association with literacy because there is a reverse causation between literacy and FARMSHR also. 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.

The way that such reverse causation can be controlled for is by instrumenting for FARMSHR. Since FARMSHR correlates well with a variety of geographical variables, 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 6 shows the effects of FARMSHR when it is instrumented by all the geographic variables listed in Table 2. Since the main objection usually leveled against geographic instruments is that they may be correlated with the agricultural sector, but in this case that is what we need, these are likely to be good instruments and to plausibly meet the exclusion restriction. The F-statistics of the first stage in the estimation are very satisfactory, above 10 in every specification, so that geography does indeed provide a strong instrument for FARMSHR.

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 even 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.

Table 6: 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 presented in parentheses and were clustered at the parish level.

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 the 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.[23]

The example of Northumberland shows that universal literacy was feasible even in an employment structure where most of the employed were labourers, and where public provision of education through compulsory taxation was not an option. There does appear to have been a general culture in the north that favored education for all, which Howkins describes as an "almost Scottish stress on the merits of democratic education".[24] 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.[25] 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".[26]

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[23] Stephens, 1990, 561.
[24] Howkins, 1991, 178.
[25] Stephens, 1987, 49-57.
[26] Houston, 2002, 257 and chapter 2.

Other compelling evidence against the geography hypothesis comes from looking at the earlier history of literacy in English counties. The geography was constant over time, and consequently even 200 years earlier, in the seventeenth century, 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.[27]

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 Becker and Woessmann finds evidence of a causal link between Protestantism and literacy and education rates in the nineteenth century Germany.[28] 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. They also show that Protestantism tended to particularly increase the education of women.[29]

We have information on the religious composition of England's parishes from the 1851 census, by local parish groups. 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 7 shows that this Protestant share varies significantly by county, and even within counties.

[27] Cressy, 1980, 76-85.
[28] Becker and Woessmann, 2010.
[29] Becker and Woessmann, 2008.

Table 7: 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.

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 indeed correlated with literacy at the parish level. Table 8 displays the results from logit regressions including a measure of the share of the population who was non-conformist Protestant.[30] The results show that the share non-conformist in a parish 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 level 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 variations in the Protestant share, 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

[30] We also ran the instrumental variables specification, including the religion variable, but do not report the results here. The results were similar to those shown in the OLS table.

rates, as opposed to Protestantism just being accidentally associated with the county with unusual high literacy rates. As Table 7 shows, however, there is little variation

Table 8: 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)
Obs	7,927	7,927	7,927	7,927
Pseudo-R^2	.05	.16	.09	.20

Notes: Columns (2) and (4) include controls for the occupations of fathers.

across counties at the parish level in non-conformism rates, so the failure to find any association may owe to this lack of within county 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 do see that geography created great variations in the social structure of the countryside. We also see significant variations in the literacy rates of rural areas in the nineteenth century. However, social inequality was not important as a 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 literacy. 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 cultural variation, we do not find evidence for the Becker-Woessmann conclusion that Protestantism was an important driver of literacy (Becker and Woessmann, 2008). Non-Conformism is positively correlated with literacy, but this correlation occurs only at the county level and not within parishes in counties. Protestantism may matter, however, 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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