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LITERACY AND AGE IN PRE-INDUSTRIAL ENGLAND:
QUANTITATIVE EVIDENCE AND IMPLICATIONS

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ABSTRACT

This paper presents multivariate estimates of the relationship between the ability to sign and a number of individual characteristics for two groups of English men and women of the seventeenth and eighteenth centuries. The results generally confirm those of other historians' studies of literacy in pre-industrial England, as they indicate that, with other things equal, men were more literate than women, and that there was a positive correlation between the ability to sign and both possession of a skilled occupation and residence in London. However the results also indicate the presence of a strong positive association between an individual's age and the ability to sign. Since those in the samples were all above the normal school-leaving age, this finding calls into question the assumption of some earlier investigations that the ability to sign was normally acquired in school, and points to the possible quantitative importance of informal education in pre-industrial England.

I. INTRODUCTION

The extent of literacy in the past has been the subject of a considerable number of quantitative historical investigations during recent decades. In the case of pre-industrial England, the analysis of such studies has relied on bivariate statistical procedures. While a number of these studies have made important contributions, their reliance on a single method of statistical analysis raises a question common in quantitative research, of the extent to which empirical results and interpretations are specific to the estimating procedures used to produce them. This paper will present an analysis of some correlates of the literacy of some English men and women of the seventeenth and eighteenth centuries in an explicitly multivariate framework. Two different multivariate regression techniques will be employed in order to gain an indication of the robustness of the results to alternative specifications.

II. ISSUES AND PAST PROCEDURES

The quantitative study of the extent and significance of literacy in pre-industrial societies holds out the promise of considerable rewards to historians for a variety of reasons. Examples of problems which hinge on a better understanding of the quantitative importance of literacy in modern history abound. Political and social historians seek to understand the effects of the growth of a mass reading public on political change and the development of popular culture.¹ Fuller

knowledge of the extent of the diffusion and of the uses of literacy among different social groups in the past further suggests the possibility of an improved understanding of such issues as the degree to which extended families could be sustained in the face of geographic separation, the extent to which differences in education fostered divergences between rural and urban populations, and the frequency with which pre-industrial households were divided internally by the possession of literacy.²

Economic historians wish to estimate the effects of improving educational levels on economic growth.³ A firmer knowledge of the nature and uses of literacy in pre-industrial societies holds out the possibility of investigation of trends in the rate of return to expenditures on education in the course of economic development, with a possible answer to the question of whether the onset of modern economic growth produced a major change in the marginal efficiency of such investments in human capital.

Answers to these broad problems based on systematic quantitative evidence are not yet available, for the quantitative study of literacy in pre-industrial societies is in a relatively early stage. Typically, as is the case for pre-industrial England, most of the efforts of historians engaged in the quantitative study of literacy have been concentrated on establishing the extent of literacy, primarily "the discovery of how great a proportion of the population could read and write at any point in time".⁴ Since censuses of pre-industrial English literacy are not available, this has necessarily entailed the investigation of the relationships between literacy and other variables whose

distributions are better known. Using the ability to sign as an index of the presence of literacy,⁵ a number of studies of pre-industrial England have found that literacy so measured was consistently related to such variables as sex,⁶ occupation,⁷ place of residence,⁸ and wealth.⁹ Several investigations have also established the broad outlines of the changes that occurred in the extent of English literacy between the early sixteenth century and the middle of the nineteenth century.¹⁰

The present investigation is part of a study of the extent of literacy among two groups of English men and women in the seventeenth and eighteenth centuries. Both groups were composed of indentured servants who emigrated to the colonies of British America during the mid-1680s and the second through the sixth decades of the eighteenth century. An earlier product of this study used bivariate analysis of the information available about these individuals to establish the magnitudes of the bivariate relationships between literacy and each of four other variables: sex, occupation, place of origin, and date of registration.¹¹ That investigation also departed from earlier studies by considering age as a determinant of literacy even above the school ages, and suggested that significant increases in the ability to sign may have occurred among some groups after the normal school-leaving age. The present paper extends the findings of the previous one by placing the analysis of the correlates of literacy into an explicitly multivariate framework. The motivation for this continuation of the analysis is an interest in establishing whether age will continue to have an independent effect on an individual's

literacy when the effects of the other independent variables—sex, occupation, place of origin, and date — are controlled for explicitly through the use of multiple regression analysis.¹² The results can therefore provide more precise information about the correlates of literacy in pre-industrial England.

III. THE DATA AND DEFINITION OF VARIABLES

The individuals in these two samples made up part of a stream of indentured servants that accounted for an estimated half of total white immigration to the colonies of British America.¹³ The records on which the analysis is based are two sets of contracts that recorded the terms under which the servants would travel to and serve in the colonies. The earlier of the collections comes from the records of the Middlesex Quarter Sessions, where the contracts of a total of 812 servants have survived from the years 1683-84.¹⁴ This collection will subsequently be referred to as the Middlesex sample. The later collection is a set of contracts which have survived for a total of 3,187 servants registered before the Lord Mayor of London during 1718-59.¹⁵ These data will be called the London sample.

Although some contracts lack information on all variables, the number of cases lost due to these omissions is relatively small; the contracts were legal documents, and they were apparently recorded in a systematic and careful fashion. The availability of information on the emigrants' ability to sign results from the requirement that prospective servants sign or

mark the contracts to indicate their consent to the terms of their bargain. It seems likely that any servant able to sign would have done so. Additionally, separate multiple regression analysis of the terms of the contracts indicates that servants who were able to sign received a positive economic premium for their education; this suggests the validity of the belief that there was a correlation between the ability to sign and the presence of other literary skills.¹⁶

The independent variables used in the present analysis were all standard entries on the contracts. The servants' age, sex, place of origin, occupation, and date of registration were the basic independent variables. Brief comments are in order concerning the interpretations of two of these. First, as in some other legal records of the period, it cannot be determined with certainty whether the place recorded on the contract was the servant's place of origin or of last residence; the former might seem more likely in view of the use of the entry of places as identifying characteristics of emigrants, but some servants might have given their most recent place of residence. And second, the absence of a recorded occupation is taken in this study to indicate that the servant had no recognized or regular occupation.¹⁷

In defining the variables used in the analysis, age was specified as a continuous variable, while all other variables common to both samples were treated as dichotomous. The servants' places of origin were divided into two groups, with one category consisting of all places in the counties of London or Middlesex, and the other including all other places. This specification is

due to the finding of earlier investigations that perhaps the single strongest geographic difference within pre-industrial England with regard to the extent of literacy was between the high rates found in London and its environs, and the low rates elsewhere in the country.¹⁸ Occupation was treated as a series of binary variables, with separate dummies for farmers, laborers, those in food and drink trades, metal and wood crafts, construction crafts, clothing and textile occupations, and a composite category of service occupations. One additional continuous variable, the date of the contract, was included in analysis of the eighteenth-century London sample, in order to check whether there was a secular trend in the ability to sign over the more than four elapsed decades covered by the contracts.

IV. REGRESSION RESULTS

Table 1 presents the estimates obtained from ordinary least squares regressions on each of the two samples. In both cases the dependent variable, whether or not the servant signed, was specified to be function of age, sex, occupation, and place of origin, while in London sample the year of registration was also included as an independent variable. The model estimated is a linear probability model, and the coefficients represent the average changes in the respective samples in the probability that an individual would be able to sign associated with unit changes in the respective independent variables.

TABLE 1
ORDINARY LEAST SQUARES ESTIMATES
DEPENDENT VARIABLE: LITERACY¹

<u>Independent variable</u>	<u>Middlesex, 1683-84</u>			<u>London, 1718-59</u>		
	<u>Estimated coefficient</u>	<u>Standard error</u>	<u>Absolute t-value</u>	<u>Estimated coefficient</u>	<u>Standard error</u>	<u>Absolute t-value</u>
Age	0.0087	0.0037	2.35	0.0107	0.0020	5.35
Sex ²	-0.264	0.044	6.00	-0.262	0.037	7.08
Occupations: ³						
Farmer ⁴	-0.127	0.066	1.92	-0.013	0.031	0.42
Laborer	-0.110	0.088	1.25	-0.011	0.037	0.30
Food & Drink ⁵	0.163	0.154	1.06	0.250	0.043	5.81
Metal & Wood ⁶	-0.013	0.108	0.12	0.191	0.037	5.16
Clothing & Textiles ⁷	0.222	0.068	3.26	0.068	0.027	2.52
Construction ⁸	0.112	0.106	1.06	0.186	0.031	6.00
Services ⁹	0.196	0.064	3.06	0.230	0.032	7.19
London & Middlesex ¹⁰	-0.063	0.043	1.47	0.077	0.017	4.53
Date ¹¹				0.0044	0.0011	4.00
Constant	0.192	0.086	2.23	0.237	0.047	5.04
R ²	.1062			.1153		
F	8.90			35.79		
n	760			3033		

Notes

1. Marked = 0, Signed = 1.
2. Male = 0, female = 1.

3. For all occupations, indicated occupation(s) = 1, all other = 0.
For all occupations, omitted group includes those with no recorded occupation.
4. Includes farmer, husbandman, ploughman, etc.
5. Includes butcher, grocer, miller, etc.
6. Includes blacksmith, cooper, metalman, etc.
7. Includes comber, tailor, weaver, etc.
8. Includes bricklayer, carpenter, mason, etc.
9. Includes barber, clerk, surgeon, etc.
10. London or Middlesex = 1; all other places of origin = 0.
11. Entered as final two digits of year of registration.

Sources

Middlesex, 1683-84: Greater London Record Office, Middlesex Section, "Plantation Indentures," MR/E; abstracted by Cregoe D.P. Nicholson, Some Early Emigrants to America (Baltimore: Genealogical Publishing Co., 1965). Also John Wareing, "Some Early Emigrants to America, 1683-4: A Supplementary List," Genealogists' Magazine, Vol. 18, No.5 (March, 1976), pp.239-46.

London, 1718-59: Corporation of London Records Office, "Memoranda of Agreements to Serve in America and the West Indies." Abstracted by Jack and Marion Kaminkow, A List of Emigrants from England to America, 1718-1759 (Baltimore: Magna Charta Book Co, 1964), and David Galenson, "Agreements to Serve in America and the West Indies, 1727-31," Genealogists' Magazine, Vol.19, No.2 (June, 1977), pp.40-44.

Two well-known difficulties arise from the use of a linear estimator with a binary dependent variable, heteroskedasticity of the residuals and the possibility that the linear specification might yield predicted values of the dependent variable that lie beyond the variable's range.¹⁹ To check the robustness of the linear estimates, the same relationships for the two samples were reestimated by non-linear least squares. The estimation procedure involves the calculation of an index as a linear function of the independent variables. The value of the standard cumulative normal distribution at the value of the index is the probability that an individual will sign, conditional on the values of the independent variables specific to the individual. The coefficients of the index are estimated by using ordinary least squares on a linear expansion of the standardized cumulative normal transformation of the index by an iterative procedure.²⁰ The resulting coefficients for both samples are shown in Table 2. These coefficients can be multiplied by an appropriate ordinate of the normal density function to calculate the effect of a change in any independent variable on the probability of signing, conditional on values of the other independent variables; estimates of the partial derivatives of the probability function with respect to each independent variable, calculated with all independent variables at their sample means, are included in Table 2.²¹

TABLE 2
NON-LINEAR LEAST SQUARES ESTIMATES
DEPENDENT VARIABLE: LITERACY

<u>Independent variable</u>	<u>Middlesex, 1683-84</u>			
	<u>Estimated coefficient</u>	<u>Asymptotic standard error</u>	<u>Absolute t-value</u>	<u>$\frac{\delta P}{\delta x_i}$</u>
Age	0.0250	0.106	2.36	0.0091
Sex	-0.911	0.209	4.36	-0.330
Occupations:				
Farmer	-0.364	0.197	1.85	-0.132
Laborer	-0.345	0.266	1.30	-0.125
Food & drink	0.400	0.394	1.02	0.145
Metal & wood	-0.039	0.286	0.14	-0.014
Clothing & textiles	0.558	0.178	3.13	0.202
Construction	0.289	0.271	1.07	0.105
Services	0.492	0.164	3.00	0.178
London & Middlesex	-0.167	0.123	1.36	-0.060
Date				
Constant	-0.844	0.247	3.24	
R ²	0.4154			
n	760			

<u>Independent variable</u>	<u>London, 1718-59</u>			
	<u>Estimated coefficient</u>	<u>Asymptotic standard error</u>	<u>Absolute t-value</u>	<u>$\frac{\delta P}{\delta x_i}$</u>
Age	0.0564	0.0090	6.27	0.0196
Sex	-0.766	0.105	7.30	-0.266
Occupations:				
Farmer	-0.159	0.089	1.79	-0.055
Laborer	-0.122	0.101	1.21	-0.042
Food & drink	0.836	0.231	3.62	0.290
Metal & wood	0.540	0.146	3.70	0.187
Clothing & textiles	0.122	0.078	1.56	0.042
Construction	0.534	0.118	4.53	0.185
Services	0.774	0.149	5.19	0.268
London & Middlesex	0.284	0.055	5.16	0.098
Date	0.0132	0.0033	4.00	0.0046
Constant	-1.264	0.180	7.02	
R ²	0.7097			
n	3033			

Notes

All variables defined as in Table 1.

Sources

See Table 1.

The similarity of the results obtained with the two estimators for both samples is reassuring, for it suggests that the estimates are not strongly dependent on the specification of a particular functional form. The following discussion will refer primarily to the non-linear estimates, which are theoretically more appropriate for most purposes.

In both samples the estimated coefficient of age is positive and statistically significant at the .05 level or better. This result is particularly interesting because even the youngest servants registered in significant numbers in both samples were above the normal school-leaving age in pre-industrial England.²² The positive association between age and the ability to sign, while controlling for sex, occupation, place of origin, and date, therefore supports the contention that significant increases in individuals' literacy in pre-industrial England may have occurred after the school-leaving age. The magnitude of the coefficients furthermore suggests that these increases may have been important quantitatively. Thus in the earlier sample, with other things equal, an increase of one year in age was associated with an increase of nearly one percentage point in the probability of signing, while in the later sample the increase was of nearly two percentage points.

The importance of these results for the quantitative study of literacy in pre-industrial England may be considerable. Interest in the quantitative measurement of the extent of pre-industrial English literacy was greatly stimulated by Roger Schofield's suggestion that the ability to sign could be used as a well-behaved

index of literacy, and virtually all studies done since the publication of his influential paper in 1968 have interpreted this index in the way Schofield suggested. Specifically, Schofield concluded that "a measure [of literacy] based on the ability to sign probably overestimates the number able to write, underestimates the number able to read at an elementary level, and gives a fair indication of the number able to read fluently."²³ Schofield based this conclusion on the ordering of the curriculum in pre-industrial English schools, as students were taught first to read, and then to write; since, for economic reasons, the duration of students' school attendance varied, insofar as formal education was responsible for literacy the ability to write would have been less widespread than that of reading.

While Schofield qualified his result with a warning that conclusions based solely on the structure of school curricula ignored the possibility that informal instruction played an important role in the diffusion of elementary literary skills, he noted that from sources then available the latter's quantitative importance could not be estimated. The data used in the present investigation offer an opportunity to give an indication of the possible quantitative importance of informal education that occurred above the age of 15 in teaching the ability to sign. Based on calculations done with the non-linear estimates of Table 2, comparing the probability of a servant two deviations below the mean age in the Middlesex sample to that of

a servant two standard deviations above the mean age, with the values of the other independent variables held at their means, would yield a probability 16.5 percentage points higher for the older servant; the analogous difference in the London sample would be 33.7 points. The linear estimates of Table 1 produce smaller differences for the same comparison, of 15.9 percentage points for the Middlesex sample and 19.9 points for London, but even these smaller effects are considerable relative to the sample mean literacy rates of 34.6 percent in the Middlesex sample and 66.9 percent in that from London. While these magnitudes cannot necessarily be projected from these samples to the English population at large,²⁴ their suggestion of the possibly substantial quantitative importance of informal education, even that occurring after the school-leaving ages, as a source of literacy in seventeenth and eighteenth-century England might make systematic investigation of its extent and structure an important item on the future research agenda of quantitative historians of literacy in pre-industrial England.

The quantitative evidence of the data under consideration can yield some additional results which suggest where historians might look for evidence of informal education by pointing to the groups among which the correlation between age and the ability to sign was strongest. The smaller size of the Middlesex sample makes it less useful for this purpose, but further regression results for the London sample are presented in Table 3. The results reported are non-linear least squares estimates of an

equation in which the model used earlier has been extended to include two additional variables. The added variables are interaction terms between age and two aggregated sets of occupations, one comprising the farmer and laborer categories, the other including the five "skilled" categories - services, food and drink, metal and wood, clothing and textiles, and construction. These additions allow the members of each of these occupational groups not only to have differentially higher or lower literacy rates, as in the regressions reported earlier, but also for the magnitude of the differentials between the groups to change with age.²⁵

The results obtained are interesting, for what they suggest is that the magnitude of the correlation between literacy and age differed considerably across these broad groups within the observed range of ages. Thus the superior literacy of the "skilled" workers is seen to consist of a combination of an initially higher probability of signing at the youngest ages observed in the sample (indicated by large, positive, and highly significant coefficients on each of the variables for the five individual "skilled" occupational categories) and a lower rate of increase of that probability with increases in age thereafter (indicated by a negative and statistically significant coefficient on the age-skill interaction variable). To illustrate with one example, while at age 15 workers with service occupations were on average 38 percentage points more likely to sign than those registered without occupations, ceteris paribus, this gap decreased to 24 points at age 20, and only 9 points at age 25. While the results are weaker statistically for the composite group of farmers

TABLE 3
NON-LINEAR LEAST SQUARES ESTIMATES, LONDON 1718-59
DEPENDENT VARIABLE: LITERACY

<u>Independent variable</u>	<u>Estimated coefficient</u>	<u>Asymptotic Standard error</u>	<u>Absolute t-value</u>	$\frac{\delta P}{\delta x_i}$
Age	0.0987	0.0173	5.71	0.0348
Sex	-0.853	0.112	7.62	-0.300
Occupations:				
Farmer	0.707	0.437	1.62	0.249
Laborer	0.732	0.426	1.72	0.258
Food & drink	2.403	0.453	5.30	0.846
Metal & wood	2.103	0.418	5.03	0.740
Clothing & textiles	1.666	0.393	4.24	0.587
Construction	2.118	0.412	5.14	0.746
Services	2.299	0.414	5.55	0.809
Interactions:				
Age-Farm ¹	-0.0481	0.0223	2.16	-0.0169
Age-Skill ²	-0.0816	0.0208	3.92	-0.0287
London & Middlesex	0.293	0.055	5.33	0.103
Date	0.0131	0.0034	3.85	0.0046
Constant	-1.999	0.312	6.41	
R ²	0.711			
n	3033			

Notes:

1. Age-farm interaction = age of individual if farmer = 1 or laborer = 1; for all others = 0
2. Age-skill interaction = age of individual if food & drink = 1, metal & wood = 1, clothing & textiles = 1, construction = 1, or services = 1; for all others = 0.

All other variables defined as in Table 1.

Sources

See Table 1

and laborers, the estimated coefficients suggest that the members of these groups might have had a pattern intermediate between the "skilled" and those without recorded occupations, as their initial probability of signing was lower than that of the skilled but higher than that of the others, and their subsequent increase with age was more rapid than that of the skilled but slower than that of the others.

Generalization of these findings to groups outside the sample must be approached with considerable caution, for not enough is known of the process by which indentured servants were recruited to warrant assertions concerning the extent to which this sample is representative of the contemporary English population with respect to the relationships under study here. However these results do have implications that might eventually be tested for larger groups when evidence becomes available. Specifically, the estimates of Table 3 suggest that informal education that occurred after the normal school-leaving age might have been relatively more important in increasing the literacy of the less skilled groups in pre-industrial English society, as the largest increases in the ability to sign with age appear for those without recorded occupations and those who worked in agriculture. Informal education may have been less important for those with skilled occupations; although some increase in the ability to sign with age appears for these individuals, it is relatively small, suggesting that most of the skilled workers who had basic literary skills acquired them before entering their occupations.²⁶

In many cases the ability to sign among rural agricultural groups may have come from instruction received within the family. In a study of literacy in two pre-industrial Cambridgeshire towns,

Margaret Spufford observed persistent literacy in successive generations of several families too poor to have been expected to spare their children from the labor force long enough to enable them to attend school. She conjectured that there may have been a tradition of literacy within some families that was unrelated to economic factors, and her recommendation that family literacy deserves further study is closely related to the suggestion here of the value of an investigation of the processes of informal education in pre-industrial England, for surely in some families literacy could have been passed directly from one generation to the next by instruction of children by their parents.²⁷

Even more strongly in this vein, Thomas Laqueur has suggested that most children in pre-industrial England learned to read and write informally, from parents and neighbors: thus "literacy was transmitted in much the same way as were traditional occupational skills."²⁸ Yet just as the transmission of occupational skills was not limited to childhood, the acquisition of literary skills may commonly have continued into adolescence and beyond: "learning to read and write was not a distinct activity undertaken during a compact period in one's life but part of a process which might go on from early childhood well into adulthood."²⁹ The quantitative evidence presented here suggests that this was the case, and that for many pre-industrial English men and women the passage into adulthood may have been marked by increasing literacy obtained through informal education, which would allow them to participate more fully in the culture of literacy that Laqueur and others have described.³⁰

In both samples the estimated coefficient of the sex variable is negative and highly significant statistically, indicating that women were less likely to sign than men. The magnitude of the coefficients is also considerable, as the non-linear estimates show that, with other things equal, women in the Middlesex sample were 33 percentage points less likely to sign than men, while the analogous differential in the London sample was 27 points. The smaller sex differential in the later sample does suggest that the gap in literacy between the sexes may have been declining over time. However, the results confirm that during the periods covered by both samples the typical level of literacy was considerably lower among women than among men, a fact familiar from other studies.³¹

As mentioned earlier, a number of studies of pre-industrial England have found that literacy rates were considerably higher in London and its surrounding area than elsewhere in England. The dichotomous independent variable which took the value one if a servant was from London or Middlesex, and zero otherwise, was intended to capture this metropolitan effect. In the later sample, its estimated coefficient is of the expected sign and highly significant statistically; it indicates that, *ceteris paribus*, servants from the metropolitan area were about ten percentage points more likely to sign than servants from elsewhere in England. However in the earlier sample the metropolitan variable's estimated coefficient is actually negative. Although not significantly different than zero, the estimate does raise the question of why no metropolitan literacy differential appears in the sample.

The answer may have to do with the fact that the 1680s was a period of intensive recruitment for indentured labor. In one major servant-importing region, the Chesapeake colonies of Maryland and Virginia, the price of white servants was bid up by 33 percent between 1677 and 1691, as a decline in the supply of whites to the region contributed to a sharp increase in the cost of English servants relative to African slaves.³² The shift in the supply of white servants may have resulted in a decline in the average productivity of the workers bound, as planters accepted less desirable servants in order to maintain a white labor force.³³ Seventeenth-century London was widely known to attract vagrants and unskilled workers, and a disproportionate share of less productive and less skilled servants of the 1680s may have been drawn by London recruiting agents from the immediate area of the port. If present, this recruiting of disproportionate numbers of less skilled workers from London would introduce a selection bias into the sample. This would have the effect of biasing the coefficient of the metropolitan variable downward relative to that which would be obtained from a random sample of Englishmen of the period. The particular circumstances of the 1680s may therefore account for the lack of a positive effect of metropolitan origin on the ability to sign in the Middlesex sample.

Among the occupational variables, only one — services — has an effect statistically significant at the .05 level on the likelihood of signing in both samples. Its effect in both cases is positive and considerable, raising the probability by 18

percentage points in the earlier and 27 points in the later sample. Each of four categories — food and drink, construction, metal and wood, and clothing and textiles — has a significant, positive, and sizeable effect in one of the two samples, and an insignificant effect in the other. Two groups, farmers and laborers, have estimated coefficients insignificant at the .05 level in both samples. These results therefore tend to place the excluded category, servants registered without occupational entries, at a level of literacy similar to that of the farmers and laborers, and on average below that of the other occupational groups, after controlling for the servants' age, sex, and place of origin. That the services category has the most consistent positive association with literacy is not surprising in view of the inclusion of many skilled professional occupations within the category.³⁴ Similarly, the apparently ranking of the other non-agricultural occupational categories as more highly literate than the farmers and laborers is consistent with the results of other studies of pre-industrial English literacy.³⁵

Finally, the possible implications of these results for the analysis of the changing literacy of the English population over time can be briefly mentioned. Effects of secular changes in the level of literacy are represented by the change in the intercepts of the linear regressions across samples and the estimated coefficient of the time trend in the later sample. Together these suggest that with the other independent variables in the equations held constant, the mean probability that a servant would sign rose by 13 percentage points during 1684-1718, and by an additional 18 percentage points during 1718-59.

However inferences from these results about trends over time in literacy among the English population as a whole must be drawn with great caution. The principal reason for this is the possible presence of selection bias, either of types discussed in this paper or of other, unknown varieties, which would make the sample analyzed here unrepresentative of the English population even after controlling for the effects of the included independent variables. However it appears that the late seventeenth century and the first half of the eighteenth did witness sizeable gains in literacy among at least some groups in the English population,³⁶ and it is possible that the considerable rates of growth calculated from the analysis of the servants' ability to sign are genuine indications of a period of generally rapid growth of literacy within England.

V. CONCLUSION

The data used in this study are unusual among sources that have been used for the quantitative study of literacy in pre-industrial England in several respects. Perhaps the most important of these is the age distribution of the sample population. Large numbers of young English men and women bound themselves to serve in the colonies of British America. Their heaviest concentration was in the ages from the early teens to the late twenties. Collections of servant contracts therefore include information about the literacy of a segment of the population below the ages

at which other pre-industrial Englishmen prepared for the events — marriage, litigation, death, and taxes — which generated the documents more frequently used in the study of literacy.

That the analysis of these data reveals the presence of relationships between literacy and other social, economic, and demographic variables similar to those found in more familiar types of sources generally serves to support the belief that the English men and women who emigrated to the colonies under indenture were sufficiently similar to the contemporaries who stayed behind to make analysis of the correlates of their literacy of some general interest. Thus as in samples drawn from other sources, the women were less literate than the men, the professionals and craftsmen were more literate than the farmers and laborers, the residents of London tended to be more literate than those from provinces, and over time on average all tended to become more literate. The conventionality of all these results only heightens the novelty of the one anomalous finding, that even after controlling explicitly for the effects of each of these other independent variables, there was a strong positive relationship between the ages of the servants and their ability to sign. Because virtually all those entering indentures were above the normal school-leaving age, this correlation raises the possibility that informal education obtained during the teen ages and after was responsible for the ability of many English men and women to sign their names. If true, this would have important implications for our understanding of the nature and uses of literacy in pre-industrial England. At a relatively straightforward level, that of interpreting the

presence of the ability to sign in terms of other more significant literary skills, an understanding of what other skills were implied by that ability based on the analysis of school curricula may have a more restricted applicability than has sometimes been assumed in the past. More information on the structure of informal education would be necessary to determine whether this is the case. Less concretely, but perhaps ultimately more crucial for our appreciation of the culture of pre-industrial England, the result would suggest that the forces leading individuals to acquire literary skills, whether these motives were narrowly economic or more diffuse and complex, continued to be felt with sufficient force during the relatively mature ages at which men and women entered society as independent members that they led significant numbers of people to seek education. Further investigation of these motives would be central to an assessment of the significance of this behavior. But what the result suggests most directly is that perhaps for many pre-industrial English men and women who lacked formal education the passage into adulthood may nonetheless have been marked by the acquisition of literary and other skill that would help them gain success in an increasingly complex society.

Of course other interpretations of the result found here are possible. The anomaly could be due to some sample selection bias associated with the indenture system, although its appearance in two samples drawn from different periods suggests that if this is the case the bias was a persistent one. However ultimately the determination of the degree of generality of the correlation

between age and literacy after the school ages, and firm estimates of the quantitative importance of informal education in pre-industrial England, will depend not on a debate over the merits of these two samples, but rather on the adduction of evidence from sources not currently available. Anyone familiar with the great progress made in describing and analyzing the history of literacy in pre-industrial England in the past ten years will recognize this statement not as discouragement but as the prediction it is intended to be.

FOOTNOTES

I am grateful to Stanley Engerman for discussions of many of the issues treated in this paper, and to Andrew Abel and Frederic Mishkin for comments and suggestions. Kevin O'Meara and Henry Otto provided able assistance with the programming.

1. E.g. Richard D. Altick, The English Common Reader: A Social History of the Mass Reading Public, 1800-1900 (Chicago: University of Chicago Press, 1957).
2. Peter Laslett, The World We Have Lost, Second edition (London: Methuen, 1971), pp. 205-10.
3. E.g. Stanley L. Engerman, "Human Capital, Education, and Economic Growth," in Robert William Fogel and Stanley L. Engerman, eds., The Reinterpretation of American Economic History (New York: Harper and Row, 1971), pp. 241-56.
4. Laslett, The World We Have Lost, p. 207.
5. See R. S. Schofield, "The Measurement of Literacy in Pre-Industrial England," in Jack Goody, ed., Literacy in Traditional Societies (Cambridge: Cambridge University Press, 1968), pp. 311-25.
6. David Cressy, "Levels of Illiteracy in England, 1530-1730," Historical Journal, vol. 20, no. 1 (1977), p. 5; R. S. Schofield, "Dimensions of Illiteracy, 1750-1850," Explorations in Economic History, vol. 10, no. 4 (1973), p. 445.
7. Cressy, "Levels of Illiteracy in England," p. 5; Schofield, "Dimensions of Illiteracy," p. 450.
8. Schofield, "Dimensions of Illiteracy," p. 444.
9. Richard Vann, "Literacy in Seventeenth Century England: Some Hearth-Tax Evidence," Journal of Interdisciplinary History, vol. 5, no. 2 (1974), p. 292.
10. Cressy, "Level of Illiteracy in England," p. 13; Schofield, "Dimensions of Illiteracy," p. 445.
11. David Galenson, "Literacy and the Social Origins of Some Early Americans," Historical Journal, vol. 22, no. 1 (1979), pp. 75-91.
12. The statements here should not be interpreted as indicating that earlier quantitative studies of literacy based on cross-tabulation have used bivariate analysis without regard to the issue of controlling for the effects of other important variables. Indeed many have, as for example investigators have noted that in comparing the literacy of men of different occupations it is

important to hold constant their regions of origin. However the advantage of an explicitly multivariate statistical approach over this type of bivariate analysis with controls is that the former allows for the more efficient simultaneous use of the available information contained in the independent variables.

A specific example of the usefulness of multivariate analysis can be given within the context of the present analysis. It would be possible for the correlation between age and the ability to sign noted in my earlier paper for the eighteenth-century sample (*ibid.*, pp. 84-86) to have been due to a fluke in the distributions of the registrations of minors and adults over the period examined. This possibility arises in periods of rapidly rising literacy rates; the first half of the eighteenth century may have been such a period. The fluke would be for the dates of registration of minors to have been generally earlier than those of adults. If the difference in the temporal distributions of the registrations of the two groups were sufficiently great, the "minors" in the sample could actually have been born earlier than the "adults." If this were the case, those registered as adults would have been brought up in a period of generally higher literacy, and, even if literacy were acquired only in childhood, would therefore have been more likely to sign than those registered as minors.

This possibility indicates the importance of controlling for the date of registration, as well as age and other variables.

This is done in the multiple regression analysis of the London sample, the results of which are presented in Tables 1-3. If the premises of the hypothesis just outlined were correct, the regressions should show no positive correlation between age and literacy, but rather a positive correlation between date of registration and literacy; the predicted sign of the coefficient of age would actually be negative, for after controlling for date of registration those registered as adults would have been born earlier than those registered as minors, and the former would have been raised in a period of lower literacy. The strong positive relationship between age and ability shown in all three tables, while controlling for date of registration, rejects the hypothesis that the observed correlation between ability to sign and age is due to the distributional effects described above.

I am grateful to Roger Schofield for suggesting this example.

13. Abbot Emerson Smith, Colonists in Bondage (Chapel Hill: University of North Carolina Press, 1947), p. 336.
14. Greater London Record Office, Middlesex Section, "Plantation Indentures," MR/E. These have been partially abstracted by Cregoe D. P. Nicholson, Some Early Emigrants to America (Baltimore: Genealogical Publishing Co., 1965). Additional contracts included in the sample analyzed here were abstracted

- by John Wareing, "Some Early Emigrants to America, 1683-4: A Supplementary List," Genealogists' Magazine, vol. 18, no. 5 (1976), pp. 239-46.
15. Corporation of London Records Office, "Memoranda of Agreements to Serve in America and the West Indies." Abstracts are contained in Jack and Marion Kaminkow, A List of Emigrants from England to America, 1718-1759 (Baltimore: Magna Charta Book Co., 1964), and David Galenson, "Agreements to Serve in America and the West Indies, 1727-31," Genealogists' Magazine, vol. 19, no. 2 (1977), pp. 40-44.
16. David Galenson, "Immigration and the Colonial Labor System: An Analysis of the Length of Indenture," Explorations in Economic History, vol. 14, no. 4 (1977), p. 372; Galenson, "The Market Evaluation of Human Capital: The Case of Indentured Servitude," University of Chicago, Center for Mathematical Studies in Business and Economics, Report 7947.
17. For discussion, see David W. Galenson, "'Middling People' or 'Common Sort'?: The Social Origins of Some Early Americans Reexamined," William and Mary Quarterly, Third Series, vol. XXXV, no. 3 (1978), pp. 449-524; Mildred Campbell, "Response," ibid., pp. 525-40; Galenson, "The Social Origins of Some Early Americans: Rejoinder," ibid., vol. XXXVI, no. 2 (1979), pp. 264-77; Campbell, "Reply," ibid., pp. 277-86.

18. David Cressy, "Literacy in Pre-Industrial England," Societas, vol. IV, no. 3 (1974), p. 238; Schofield, "Dimensions of Illiteracy," p. 444.
19. Arthur S. Goldberger, Econometric Theory (New York: Wiley, 1964), p. 249.
20. On the probit transformation, see e.g. Henri Theil, Principles of Econometrics (New York: Wiley, 1971), pp. 630-31. The Gauss-Newton method is described by G. S. Maddala, Econometrics (New York: Wiley, 1977), pp. 174-75.
21. Non-linear least squares estimates were obtained for

$$P = F(XB) + U,$$

where P is the dichotomous literacy variable, F the cumulative standard normal distribution, X a matrix composed of the observations for each person in the sample of each of the independent variables, B a vector of coefficients, and U an error term. Using the resulting estimates,

$$\hat{p} = F(\hat{X}\hat{B}),$$

the derivative of the probability function with respect to any independent variable can be written as

$$\frac{\delta \hat{P}}{\delta x_1} = F'(\hat{X}\hat{B}) \hat{B}_1 = f(\hat{X}\hat{B}) \hat{B}_1.$$

The estimates of $\frac{\delta \hat{P}}{\delta x_1}$ presented in Table 2 were evaluated at the respective sample means of $\hat{X}\hat{B}$; the value of the probability

29. Ibid., p. 259.
30. Ibid., passim; Altick, The English Common Reader, Chaps. 1-3; Victor E. Neuberg, Popular Literature: A History and Guide (Harmondsworth: Penguin Books, 1977), Chaps. 2-3.
31. Cressy, "Levels of Illiteracy in England," p. 5; Schofield, "Dimensions of Illiteracy," p. 445.
32. Russell Menard, "From Servants to Slaves: The Transformation of the Chesapeake Labor System," Southern Studies, vol. XVI, no. 4 (1977), pp. 372-73.
33. Ibid., p. 389.
34. On the literacy of those in professional occupations, see Cressy, "Levels of Illiteracy in England," p. 5; Schofield, "Dimensions of Illiteracy," p. 450.
35. Schofield, "Dimensions of Illiteracy," p. 450; David Cressy, "Literacy in Seventeenth Century England: More Evidence," Journal of Interdisciplinary History, vol. VIII, no. 1 (1977), p. 148; Cressy, "Levels of Illiteracy in England," p. 5. This is particularly true in view of the fact that the farmers in both samples came predominantly from the lower ranks of agricultural occupations in terms of wealth and education, as nearly all were farmers and husbandmen rather than yeomen.

36. E.g. see Cressy, "Literacy in Pre-Industrial England," p. 233.

function associated with this value is the predicted mean probability of signing for the sample.

22. For the age distributions of those in the samples, see Galenson, "Literacy and the Social Origins of Some Early Americans," p. 79. The normal school-leaving age in the seventeenth and eighteenth centuries was not above 15; Cressy, "levels of Illiteracy in England, p. 11; Lawrence Stone, "Literacy and Education in England 1640-1900," Past and Present, no. 42 (1969), p. 99; R. S. Schofield, "Age-Specific Mobility in an Eighteenth Century Rural English Parish," Annales de Démographie Historique (1970) p. 266.
23. Schofield, "The Measurement of Literacy in Pre-Industrial England," p. 324. It should be noted that while Schofield stated this result specifically for the early nineteenth century, he noted that "the structure of education was basically the same at least from the sixteenth century, and it is therefore probable that the relationships between ability to sign, ability to read, and ability to write remained the same throughout this period"; ibid., p. 324.
24. For discussion of one example of a possible sample selection bias that could tend to produce the observed relationship, see Galenson, "Literacy and the Social Origins of Some Early Americans," p. 85.

25. For a description of this procedure, see Potluri Rao and Roger LeRoy Miller, Applied Econometrics (Belmont, Cal.: Wadsworth Publishing Co., 1971), pp. 98-99.
26. The relatively high literacy rates of those in the London sample at all ages suggests that many eighteenth-century parents may have agreed with the advice of R. Campbell, who wrote in 1747: "There are some Parts of Education that are useful and necessary in almost all Trades, as well as some that are adapted to particular Professions: . . . I would in this Place recommend those Branches of Education that are necessary in every Profession. Reading and Writing are so useful, that we need not, it is presumed, use many Arguments to recommend Children being well founded in these before they are bound [as apprentices]"; R. Campbell, The London Tradesman (London: T. Gardner, 1747), pp. 19-20.
27. Margaret Spufford, Contrasting Communities: English Villagers in the Sixteenth and Seventeenth Centuries (Cambridge: Cambridge University Press, 1974), pp. 203-04.
28. Thomas Laqueur, "The Cultural Origins of Popular Literacy in England," Oxford Review of Education, vol. 2, no. 3 (1976), p. 257.