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Gregory Clark; Ysbrand Van Der Werf

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Work in Progress? The Industrious Revolution

GREGORY CLARK AND YSBRAND VAN DER WERF

England moved in the eighteenth century from an economy in which technical change was sporadic to a modern economy in which technological advance is persistent and expected. Why this happened is one of the mysteries of economic history. Could changes in the desires and aspirations of ordinary people have triggered this change? What kind of world was preindustrial England? Was it like the England of 1850 at the end of the Industrial Revolution, where manual workers in both industry and agriculture worked long hours in a year-long grind: ten hours per day, 300 days per year? Or was it a world of leisure and laughter where people rested often, worked sporadically, and cared little for material consumption, preferring religion, festivals, love, sport, and war?

Both Jan de Vries and Joachim Voth have argued for an "industrious revolution," as de Vries dubbed it, that preceded the Industrial Revolution, and which consisted of increased family labor per year. De Vries locates this revolution in the seventeenth century in England and argues that it was the consequence of the appearance of a new range of consumer goods. New consumption possibilities led families to work more and enjoy less leisure. Voth, however, detects an industrious revolution much later, in late eighteenth-century London, where court records show longer work hours in 1800 than in 1760.[1] Thus we now have multiple putative "industrious revolutions" in English history. Certainly historians of medieval work life routinely assume the work year was much less than 312 days because of 50 or 60 days of religious holidays. And they also assume that aside from these enforced constraints workers exhibited little desire to labor longer than was needed for basic subsistence.[2]

An industrious revolution would certainly help resolve some nagging puzzles of English economic development between the Middle Ages and the end of the Industrial Revolution. The first of these is the puzzle of why England was seemingly so agrarian in the Middle Ages, even in the years 1400 to 1500. Budget studies show a stable relationship for nineteenth-century families between income and food consumption. At higher incomes proportionately less was spent on food.[3] Real day wages of artisans and laborers in the period 1400 to 1500 were at extraordinarily high levels. Wages then were about one-third *higher* than for similar workers in 1850 at the *end* of the Industrial Revolution. Even in the early fourteenth century, when medieval society was supposedly at the Malthusian subsistence margin, artisans' wages averaged 75 percent of their level in 1850.[4] The implication is that food products in the fifteenth century should have constituted only one-third of output.[5] Yet there was so little urbanization in England before 1500 that it is believed that 75 to 80

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Gregory Clark and Ysbrand van der Werf, Department of Economics, University of California, Davis, CA 95616-8578.

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[1] de Vries, "Industrious Revolution"; and Voth, "Time."

[2] See, for example, Dyer, *Standards*, pp. 222–33.

[3] See Clark, Huberman, and Lindert, "British Food Puzzle," p. 224.

[4] Phelps-Brown and Hopkins, "Seven Centuries," pp. 193–96.

[5] Food consumption was less than 30 percent of total consumption in 1850, and agricultural workers were correspondingly only 25 percent of the labor force. See Clark, "Labour Productivity," p. 230.

percent of the population was employed in agriculture.[6] How could medieval English society spend only one-third of its income for food, yet employ most of the population in agriculture? We would escape this conundrum if annual incomes in preindustrial England were much lower than the day wages suggest because workers worked few days per year, and few family members worked. Then much more of income would be spent on food and large numbers would be employed in agriculture.

A related puzzle concerns output per worker in agriculture. In 1850 when only about a quarter of the labor force was employed in agriculture, output per adult male worker was the equivalent of 250 bushels of wheat per year. In 1300, if three quarters of the labor force was in agriculture, output per worker would have been only the equivalent of about 56 bushels per year. Very little of this seeming increase in output per worker can be explained by higher yields or by new techniques. The major tasks of labor in agriculture—threshing, reaping, mowing, hedging, ditching, and carrying dung—remained largely unchanged from 1300 to 1850. This puzzle led one of the authors to speculate that labor intensity in agriculture must have increased between 1300 and 1850.[7]

Despite the work of de Vries and Voth we still, however, know little of the work habits of most workers in the years before 1800. The surviving records from before 1800 rarely specify the number of hours worked per day, or the number of days worked per year. Nor is it recorded what percentage of women and children engaged in production.[8] Thus Bienefeld in his book on the history of work hours is reduced to citing guild rules and wage statutes as sources for hours in the medieval period.[9] This note seeks to develop indirect methods of measuring work input in preindustrial England. Although more data are needed for any firm conclusion, when these methods are applied to the existing information, they suggest at best small increases in the labor input of rural workers all the way from 1260 to 1850.

DETECTING AN INDUSTRIOUS REVOLUTION

The total work effort of each household is

"Hours" worked per day × *Days worked per year* × *Number in the household working*

Even though we lack direct evidence on each of the elements of this formula, we can use economic reasoning to infer the effective hours of work per year for male workers going as far back as 1267. Consider first hours per day. Suppose there is a manual task that is unchanged over time and that produces a measurable output, such as threshing grain or sawing wood. Suppose also that the workers who do this task are paid sometimes through a piece rate and sometimes with a day wage. This was true for both threshing and sawing. Then if employers seek to minimize labor costs the amount of work completed per day by piece workers will be such that, approximately,

$$\textit{day wage} = \textit{work rate} \times \textit{piece rate}$$
$$\Rightarrow \quad \textit{work rate} = \textit{day wage/piece rate}$$

If this condition is not met employers will have an incentive to switch all workers to the

[6] See Wrigley, "Urban Growth," p. 700. There is a strong relationship across modern countries between the percentage of the population that is urban and the percentage engaged in agriculture, with typically at least 80 percent of rural dwellers being supported by agriculture. Dyer has recently argued that the share of the population in urban areas was as high as 20 percent. See Dyer, "How Urbanized."

[7] See Clark, "Labour Productivity."

[8] Cooking, cleaning, and child rearing are all just as much production activities as any other. The question here is whether women and children took more leisure in early societies than they took by the time of the Industrial Revolution.

[9] Bienefeld, *Working Hours*, pp. 13–19.

cheaper wage payment system for that task.[10] "Hours" is in quotations above since the work rate will depend both on the number of hours worked per day and on the intensity of labor. We can use similar logic to infer the days worked per year. If workers were employed by the year and by the day the days per year of the annual workers similarly should be,

$$days\ per\ year = annual\ wage/day\ wage.$$

There are complicating factors such as that yearly workers have more security and might thus accept a lower daily wage, or they may be better workers and so get a higher daily wage.[11] But as long as the selection process is the same over time we can use these payment ratios to look at relative days worked per year over time.

There is a further way to check on the number of days worked annually. As noted above, nineteenth century budget studies of cross-sections of workers suggest that there is a stable relationship between real income and real food consumption which is approximately of the form,

$$food_a = cwage_a^b$$

where $food_a$ is annual real expenditure on food, $wage_a$ is the annual real income, and b and c are parameters, with b typically estimated as being between 0.6 and 0.7. If N is the number of days typically worked per year by workers paid by the day then we can rewrite this expression in terms of food expenditure per day, $food_d$, as

$$365 \times food_d = c(N wage_d)^b$$

where $wage_d$ is the day wage. Taking logarithms of both sides and rearranging, this gives

$$ln(food_d) = ln(c/365) + b ln\ N + b ln(wage_d)$$

Thus if workers hired by the day typically worked small numbers of days in the years before 1700, their food consumption per day of work should be smaller than workers in the nineteenth century who typically worked 300 days per year. Figure 1 shows for 73 farm workers in England and Wales in the years 1834 to 1893 the food consumption relative to the day wages.[12] Also shown is the fitted relationship for these observations, when the expression

$$ln(food_d) = a + b ln(wage_d) \quad (1)$$

was estimated. At the average wage of 25 d. per day, workers would receive food worth 11 d. per day if the farmer fed them, which was 42 percent of the wage. Only because laborers in the nineteenth century worked 300 or so days per year could they afford to both feed themselves on Sundays, buy shelter and clothing, and provide for wives and children. If the typical worker in the years before 1700 typically worked only 200 days per year, for example, the diet provided for them by employers would have to be a smaller proportion of

[10] There are many reports in the contemporary agricultural literature that piece-rate workers tended to work harder than time-rate workers. In this case the work rate of piece rate workers would be a bit higher than predicted by the equation *work rate = day wage/piece rate*. But as long as this work-rate difference was constant over time (and there is no reason why it should not be) it will not affect our estimate of relative work rates in different eras.

[11] Employers may pay less per day for annual workers than for day workers because they then have less flexibility about labor use. But as long as the premium does not change over time the relative work rate over time can be estimated as above.

[12] Real wages are normalized to those of the 1860s using the price index of Phelps-Brown and Hopkins.

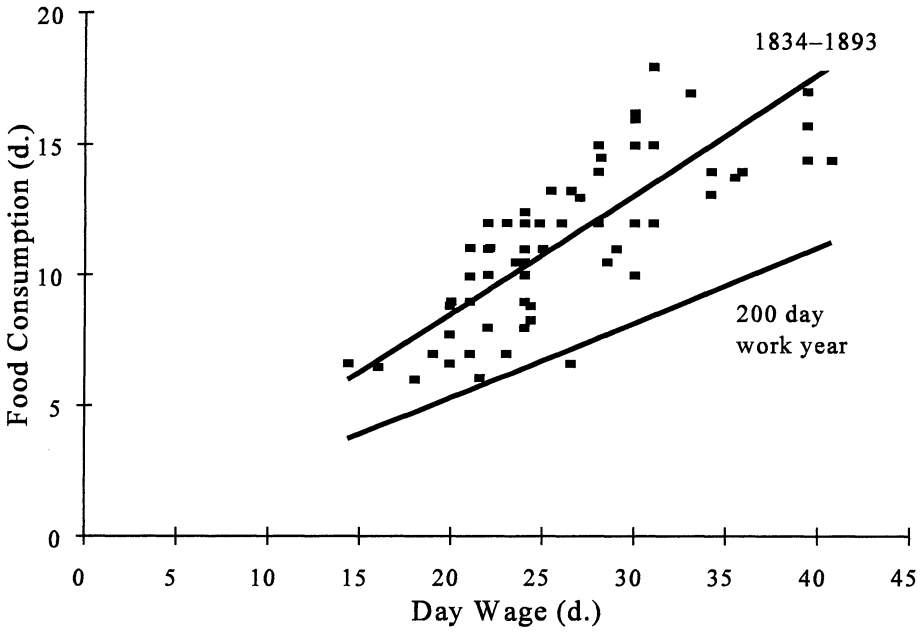

FIGURE 1
FOOD CONSUMPTION AND THE DAY WAGE, ENGLAND AND WALES 1834-1893

Note: The figure is based on 73 observations of the day wages of agricultural workers in England and Wales from 1834 to 1893 along with either the stated food allowance to workers per day, or the food allowance implied by the difference between wages with and without food. The day wage and implied food consumption were adjusted to the prices of 1860-9 using the Phelps-Brown and Hopkins cost of living index.

Sources: U.K., *Report on the Poor Laws*, pp. 100, 120, 269, 273, 443, 553, 558, 563; U. K. *Return of the Average Weekly Earnings, 1860;*U.K., *Return of the Average Weekly Earnings, 1861*; U.K., *Employment of Children*; U.K., *Return of the Average Weekly Earnings, 1869;* U.K. *Second Report of the Commission on Employment of Children*; U.K., *Third Report of the Commission on Employment of Children*; U.K., *Fourth Report of the Commission on Employment of Children*; and U.K., *Royal Commission on Labour.*

their wage to allow for food consumption on nonwork days and the many other demands on their incomes.

MEN'S HOURS PER DAY

We can infer "hours" of labor per day all the way from the 1260s to the 1850s using the payments by the day and by the piece to sawyers and threshers, since both tasks seemingly changed little. But we must put quotes around hours because we are estimating the amount of work done per day, which is a combination of time and labor intensity. From 1200 to 1850 grain was threshed by beating the harvested stalks with a jointed wooden stick, known as a flail, to dislodge the grain. After threshing, the grain was separated from the chaff by winnowing. Primitive winnowing methods included tossing the grain into the air and letting the breeze carry away the chaff, or tossing the grain lengthwise along the barn floor so that air resistance sorted out the heavier grain from the lighter chaff. Even in the Middle Ages winnowing machines that created their own breeze from a hand-cranked fan were also used. Sawyers from the earliest times worked in pairs and were paid either by the day or per hundred square feet of wood sawed. The saw used by sawyers was the two-man pitsaw, composed of the blade and the "frame," which was the handle that held the blade. One sawyer

stood in the pit, the other atop the wood being sawed. There are no specific innovations in the years 1260 to 1800 which should have changed work rates, but incremental improvements in blade design and quality may have occurred.

We have observations on piece rates and day wages, or inferred day wages, for both sawyers and threshers as early as the thirteen century. To use the piece rates where we do not get a quote of a day wage we inferred threshers, or sawyers, day wages from laborers' or carpenters' day wages. We converted carpenters' wages into laborers' wages by using the ratio for each half century of artisans' laborers wages to those of the artisans, and assuming threshers were paid the same as laborers.[13] We inferred sawyers day wages from those of carpenters using the general relation for each half century of sawyers and carpenters day rates. Since wages and piece rates were generally stable year to year we used a day wage from an adjacent year if no wage was available for the year of a piece rate.

For threshing we can calculate the daily work rate on three different grains—wheat, barley, and oats—and use a weighted average of these rates.[14] We have 1,222 individual threshing observations for the period 1267 to 1850 from locations throughout England. The data are drawn from a variety of sources: manorial and farm accounts, estimates of village or county threshing payments by observers such as Arthur Young, and the wage rates fixed by magistrates under the Statute of Labourers.[15] The piece and day rates quoted for any place tend to change little from year to year. Thus to avoid overweighting observations from places that produced many observations ten year averages of piece rates and day rates were used. This reduced the data to 560 observations. The expression fitted to the data was

$$\ln Z_d = \Sigma \alpha_i d_i + \beta d_{wass} + \delta d_{carp} + \gamma d_{somerset} \qquad (2)$$

where Z_d is the threshing rate, the d_i are dummy variables for the different time periods, d_{wass} is a dummy variable for observations draw from county wage assessments (as opposed to actual transactions), d_{carp} is a dummy for cases where the day wage for threshers was inferred from carpenters' wages, and $d_{somerset}$ is a dummy for observations from Somerset where the bushel measure seems to have been unusually large. The logarithmic form was chosen on the grounds that the errors were likely to be proportional to Z_d. The numbers shown in Figure 2 are the $e^{\hat{\alpha}_i}$ estimated from the fitted regression. Also shown in Figure 2 are the 95 percent confidence intervals around each estimate.

As can be seen instead of an upward trend in threshing rates, which we would expect if there was an industrious revolution among male workers, there is a clear downward movement in work rates from 1300 to about 1600, and then no trend at all.[16] The variations in the threshing rates were not the result of changes in the relative prices of labor and grain. If grain was expensive relative to labor, threshing might be done more carefully to extract more of the grain from the straw, so slowing up the threshing rate. But Figure 2 also shows the average wage in terms of grain for our observations by half centuries. The large movements in the cost of labor clearly had very little effect on the threshing rate in each half century.

[13] The data for this calculation came from Thorold Rogers, *History*, vols. 2 and 3. The artisans used were carpenters, masons, tilers, and slaters. The ratio of laborers wages to the artisans wage was 0.59 in the years before 1350, 0.63 from 1350 to 1400, and 0.63 from 1400 to 1500.

[14] To make the rates comparable barley threshing rates were divided by 1.61, and oats rates by 2.00, which was the overall implied ratio of work rates on the different grains.

[15] Clark "Agricultural Wages" gives the sources. The wage assessments, fixing maximum allowable rates, probably set wages at levels below market rates. But here we are using the ratio of day wages to piece rates, so as long as the relative wages were set with some idea of the normal work rate in threshing this data conveys information.

[16] Beveridge, "Wages," gives details of wages for the Winchester manors that suggests even higher threshing rates of as much as 8 bushels per day in the years before 1450. The 12 cases in our data, however, where the actual amount threshed per day is specified show a threshing rate of only 4.5 bushels per day.

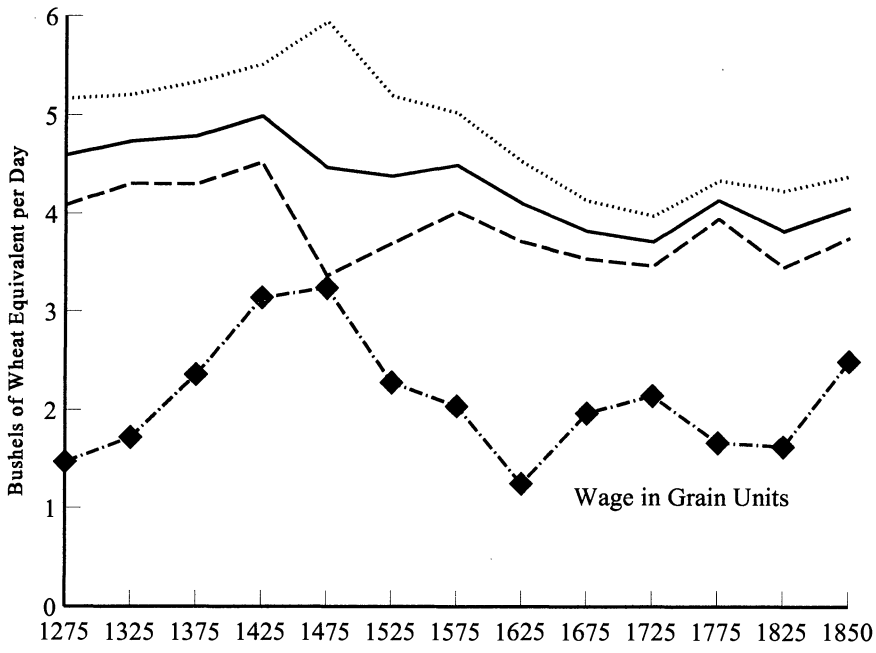

FIGURE 2
BUSHELS OF WHEAT THRESHED AND WINNOWED PER DAY, 1267–1850

Notes: The dotted lines show the 5 percent confidence intervals for the estimated sawing rate in each period. The bottom curve shows the threshing payments deflated by the prices of grain.
Sources: Rogers, *History*, vols. 2, 3, 6, 7 and the manuscript sources listed in Clark, "Agricultural Wages."

We have 735 sawing observations for the 1280 to 1810 period from a variety of locations. Figure 3 shows the estimated sawing rate in hundreds of square feet per day over this period. As with the threshing data, we estimate these rates using an equation of the form

$$\ln Z_d = \Sigma \alpha_i d_i + \beta d_{carp}$$

where Z_d is the sawing rate, the d_i are dummy variables for the different time periods, d_{carp} is a dummy for cases where the day wage for sawyers was inferred from carpenters wages. Again the numbers shown in the figure are the $e^{\hat{\alpha}_i}$, along with their 95 percent confidence intervals.

As Figure 3 shows there is an increase of almost 80 percent in the estimated number of feet sawed per day between 1300 and 1800. The increase is concentrated in two periods however. The work rate is fairly constant from 1280 till the early fifteenth century. It then jumps nearly 40 percent between 1425 and 1475. Thereafter the rate is stable at a little over 100 square feet per day until the late eighteenth century. There is a further increase of about 20 percent in the sawing rate in the late eighteenth century, though here there is so little data that this may be a result of errors in the data. This shows up in the wide error margins of the later observations.

Though the overall rise in sawing rates is consistent with an industrious revolution having occurred in preindustrial England several factors suggest that the increase was more likely caused by improved sawing technology or a change in the way the "hundred feet" was measured. The greatest increase in rates, of about 40 percent occurs between 1420 and 1460. In this same period the threshing rate does not change as would be implied by any general

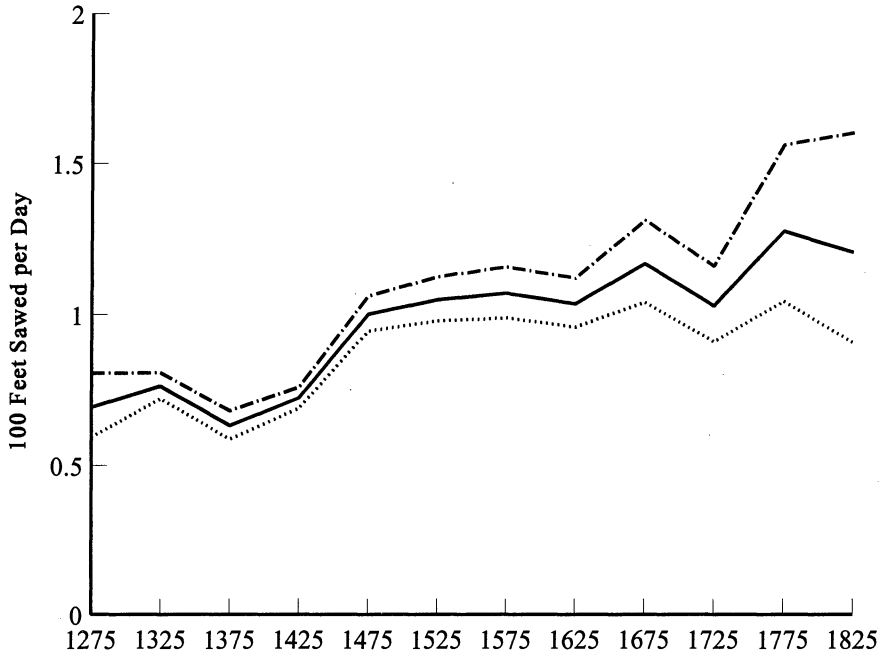

FIGURE 3
HUNDRED FEET SAWED PER DAY, 1280–1800

Notes: The dotted lines show the 5-percent confidence intervals for the estimated sawing rate in each period.
Sources: Rogers, *History*, vols. 2, 3, 6, 7 and the manuscript sources listed in Clark, "Agricultural Wages."

industrious revolution. The later increase in rates in the late eighteenth century is based on only nine observations and occurred at a time when mechanical saw mills began to replace hand sawing. What is very clear from the sawing data is that there was no change in sawing rates between 1500 and 1750, the period de Vries identifies as that of the industrious revolution. Taken in combination the threshing and sawing data suggests little gain in hours or intensity of work per day all the way from 1267 to 1850. Workers seemingly did as much per day in medieval England as in England at the end of the Industrial Revolution.

MEN'S DAYS PER YEAR

Rural workers may have worked long and hard on the days they worked, even back in the Middle Ages, but how many days per year did they work? Accounts of the complete days worked per year by workers are difficult to find in the surviving farm accounts. But the evidence shows that even before 1750 some workers were putting in work years of nearly 300 days. Thus on the Harrold estate in Bedford over the account year 1647/48 four regular workers worked for this employer on average 291.5 days.[17] Of the 21.5 idle days per worker (excluding Sundays), 14 were potentially common to all the workers and may reflect regular holidays (four of these were from the Christmas and New Year period). The other 7.5 were definitely idiosyncratic to individual workers. The household accounts of a curate in Cambridge in 1705/06 show that Thomas Watson, an agricultural laborer,

[17] Assuming they worked a full six-day week for the eight-week harvest period where the information is incomplete. Bedford Record Office, Harrold MSS. TW 802/1-31.

worked 296.5 days in one year.[18] On the Dryden estate in Northampton five regular workers who were employed in 1727/28 worked for this employer respectively 288, 264, 297, 296, and 300 days. For only six days in the year were all the workers absent implying that this was a general holiday. In Christmas week 1728, for example, all the workers only worked 5 days. Finally on the Oakes estate in Derbyshire in 1772 five regular workers put in respectively 308.5, 309.5, 311, 301, and 300.5 days for this employer.[19]

These estate and farm accounts, sparse though they are, do show that even long before the Industrial Revolution *some* rural workers were working 290 or more days per year. There was certainly no norm of short work weeks before 1770. Unless these regular employees were very atypical agrarian workers as early as 1650 had labor inputs not unlike full-time workers in the nineteenth century.

Another source of evidence on annual days worked is the annual earnings of full-year employees relative to the average day wage. Workers paid by the year typically received a cash wage plus food and lodging. Where we are told the value of that food and lodging for the year we can infer the total value of the yearly wage. Assuming employers minimize labor costs this annual wage divided by the day wage will indicate the number of days worked per year by annual workers. Table 1 shows this evidence for the years 1560 to 1870. In 1867/70 the ratio of annual to day wages is close to the 300 days that other estate account evidence suggests was the work year. Arthur Young's data for 1771 suggests a very similar picture of the agrarian work year, with no strong sign of a much lower expected yearly labor input. The data from Holkham in Norfolk and from three wage assessments for the early eighteenth century again suggest that workers employed by the year would be expected to work close to 300 days. The wage assessments for the sixteenth and seventeenth centuries, however, do allow for some possible increase in the normal work year. For by the time we get back to 1560 to 1599 the ratio of the maximum yearly to the maximum daily wage is down to 257 days, which would imply a typical work week of 5 days as opposed to the norm of six in the nineteenth century. There may have been modest increases in the expected length of the work year, though the wage assessments are a much more indirect source than actual transactions.[20]

There is no evidence on the annual wage of *full time* estate workers before 1560. The *famuli* on the medieval estates—ploughmen, carters, cow herds, and shepherds—were employed year round. But David Farmer has argued that the *famuli* were not generally full-time employees but would have farms of their own that they also tended to. Thus on two Glastonbury manors in the fifteenth century, which listed the names of the *famuli*, he finds most of them also rented holdings, some of which were as large as 16 acres. He concludes of medieval estate workers "One must assume they were not so busy working for the lord that they had no time to work the lands they rented."[21]

There is evidence, however, on the ratio of wages with food to wages without food for the years 1280 to 1602, mainly for rural craftsmen. Figure 4 shows for these workers the day wages, measured in pence of 1860/69, and the implied food consumption.[22] Also

[18] Brassley et al., *Accounts*, pp. 154, 167, 184, 194.

[19] Sheffield City Library, Oakes MSS, 1518.

[20] It is possible that adult males in 1850 worked more than in 1700 or 1600 by doing other work at by-employments beyond their 300 days of regular employment: either more days of work or work in the evenings. The data on "hours" per day and days per year from day wages would not detect this. But for rural areas in the 1850s the possibility of large-scale by-employments by men seems remote.

[21] Farmer, "*Famuli,*" pp. 228–29. Not appreciating this Clark, "Productivity Growth," used estate workers' annual wages to estimate the implied day wage of agricultural workers circa 1300. This wage was then used to compute an implied threshing rate, which was also correspondingly too low. Robert Allen pointed out the inconsistency of this threshing rate with other rates for the period.

[22] For comparability with nineteenth-century agricultural laborers, only the 72 workers with wages below 45 d. per day are shown.

TABLE 1
INFERRED DAYS WORKED PER YEAR

Period	Number of Observations	Annual Wage: Money	Annual Wage: Food and so forth	Annual Wage: All	Average Day Wage (pence)	Implied Work Days per Year	Standard Error of Estimate (days)
1867–1869, England	7	14.0	21.8	35.8	28.7	293	13.4
1867–1869, Wales	5	15.4	14.6	30.0	23.2	311	5.9
1870, Scotland[a]	27	-	-	37.3	28.4	318	6.0
1771, England	10	6.4	9.1	15.5	12.4	280	12.9
1733–1736, Norfolk	24	6.4	12.0	18.4	14.9	295	4.6
1700–1732, England	*3*	*4.7*	*8.4*	*13.0*	*11.1*	*286*	*13.7*
1685, Deptford	2	-	-	31.2	24.0	312	-
1650–1699, England	*16*	*3.9*	*7.3*	*11.2*	*10.2*	*276*	*6.5*
1600–1649, England	*12*	*2.2*	*6.1*	*8.3*	*7.6*	*266*	*5.9*
1560–1599, England	*17*	*1.8*	*5.8*	*7.5*	*7.1*	*257*	*4.8*

[a] Annual wages in these cases are for plowmen, and day wages for ordinary workers. Ploughmen seem to have been regarded as slightly more skilled, which will bias upwards the estimated days.

Notes: The figures in italics are calculated from the wage assessments of local magistrates.

Sources: For 1867–1870, United Kingdom, House of Commons, *Employment of Children*; for 1771, Young, *Six Months Tour*; for 1733–1736, Rogers, *Agriculture and Prices*, Vol. 7, pp. 636–704 for 1685, Rogers, *Agriculture and Prices*, Vol. 6, p. 648. Wage Assessments are listed in Clark, "Agricultural Wages."

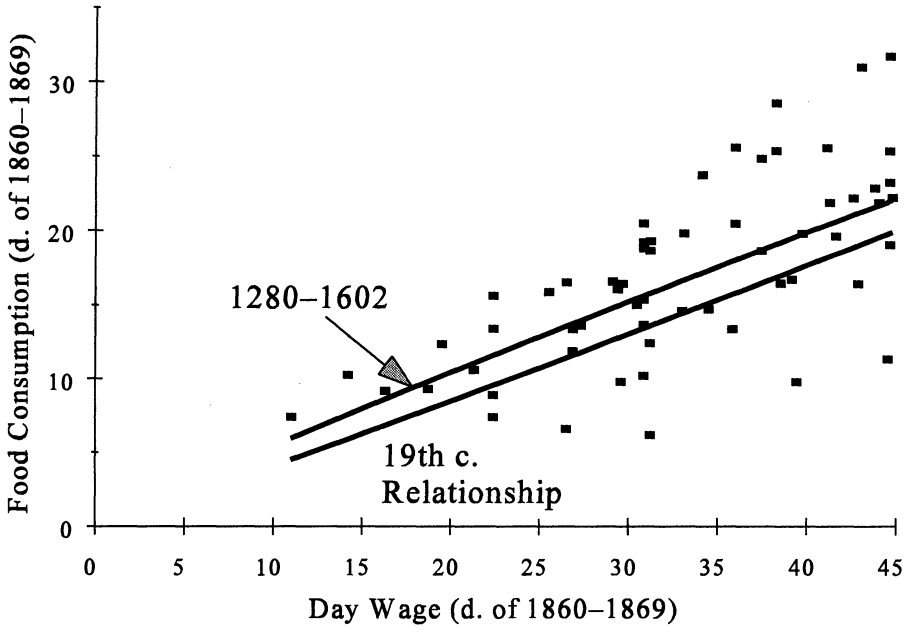

FIGURE 4
DAY WAGES AND FOOD CONSUMPTION, 1280–1602

Notes: The day wage and implied food consumption was adjusted to the prices of 1860-9 using the Phelps-Brown and Hopkins cost of living index.
Sources: Rogers, *History*, vols. 2, 3, 6; Harland, *Shuttleworths*; and Phelps-Brown and Hopkins, "Seven Centuries."

portrayed is the best fit line when equation 1 is fitted to the data. In comparison the best fit line for the nineteenth-century laborers is also shown. As can be seen workers before 1602 at a given level of real income consumed more food per day than those of the nineteenth century: 52 percent of the day wage as opposed to 42 percent. There is thus no evidence of any increase in days worked per year between the Middle Ages and the nineteenth century. Indeed in the years before 1349 artisans received 55 percent of their daily wages as food. This implies that even in the Middle Ages they had to work at least 201 days per year just to pay for their food alone. When we add in clothing and shelter, and support of women and children, the work year would have to be considerably longer.

The high implied food consumption per day of medieval workers suggests that at a given day wage they had high annual real incomes, and thus must typically have worked as many days per year as in the nineteenth century.

THE LABOR OF WOMEN AND CHILDREN

So far we have examined only the labor inputs of adult males. For this group there is little sign of any "industrious revolution" in England. But labor input per family could also have been increased by higher participation rates in market work by women and children. Measuring the labor input of these other groups is, however, difficult. We can safely assume that almost all adult male workers engaged in labor, so all we need to do is estimate how hard they labored. For women and children we can make no such presumption. We need to know how many engaged in labor and how long they worked.

The manorial and estate records we have used to infer adult male labor patterns are not helpful here. Women and children appear much less frequently than men but that could be

TABLE 2
OCCUPATIONS AND EARNINGS IN 1851, ENGLAND AND WALES

	All	Occupied	Earnings (Men = 1)	Percent of All Occupied	Percent of All Earnings
Men (15–64)	5,213,934	5,029,810	1.00	56.0	79.0
Women (15–64)	5,349,028	2,931,148	—	32.7	16.9
[a]Wives	2,863,522	1,297,175	0.20	14.5	4.1
Unmarried	2,485,506	1,633,973	0.50	18.2	12.8
[b]Children (10–14)	1,913,357	866,751	0.27	9.7	3.7
[b]Children (5–9)	2,092,359	148,558	0.18	1.7	0.4

[a] The census of 1851 only ascribes occupations to about 300,000 of the 2.9 million married women. Horrell and Humphries argue that many more of these women would be wage earners. Thus for married women we calculate the occupation rate and relative earnings using the numbers reported for working class families by Horrell and Humphries "Women's Labour" pp. 98, 107 for the period 1846–1865.
[b] The occupation rate and earnings for children aged 5–9, and 10–14 is calculated from Horrell and Humphries "Exploitation" pp. 497, 500 using the information for the period 1840–1872.
Sources: United Kingdom, House of Commons, *Census*, pp. ccxxii–ccxxvii; and Horrell and Humphries "Women's Labour" and "Exploitation."

because they engaged more in small scale industry than in agricultural and building labor. They may also have engaged in production activities that left no documentary trace such as gleaning after harvest, vegetable gardening, keeping cows on the village common, and domestic clothing production.

Although it is impossible to estimate the amount of labor performed in general by women and children including nonmarket production, we can find some evidence that suggests that the increase in *market work* by women and children between 1300 and 1850 was probably of less significance to overall labor input in the economy than de Vries would imply. Table 2 constructs an estimate of the share of total earnings in England in 1851 that came from the labor of women and children, using the census as a base. Sara Horrell and Jane Humphries argue that the census did not count as occupied a large number of married women whose work would have been part time. Thus the census lists count only about 300,000 out of 2.9 million married women aged 15 to 64 as having an occupation even though Horrell and Humphries's estimate that in laboring families 45 percent of women in this period earned some income. Table 2 thus estimates the earnings of married women using Horrell and Humphries estimates of participation and earnings. For unmarried women the census figures are used, and the wage is assumed to be half that of men (since the unmarried women were disproportionately young). For children again Horrell and Humphries's numbers for participation and earnings are used, since these suggest many more were occupied than the census lists.

Even with these corrections, however, it emerges that even in 1851 at the end of the supposed industrious revolution women and children earned only 21 percent of market incomes in 1851. Indeed the labor of all children aged 5 to 14 is calculated as being only 4.1 percent of all labor income, and that of married women is again only 4.1 percent of all income. Thus even if no married women or children were engaged in the market economy before 1700 the total labor supply per capita would have been only 8 percent smaller. If adult males, and adult males only, labored in England before 1700 the labor supply would have been 21 percent less.

Further there is limited, but suggestive, evidence that women were very active in the wage-labor market as early as the fourteenth century and indeed may have been as active as they were in 1851. When the Black Death drove up the market wage rate after 1349 the authorities tried to regulate wages through the Statute of Labourers. Laborers were required

to take no higher wages than was customary before 1349. If demand for male and female labor moved up equally after the Black Death, and men and women were equally likely to be prosecuted for breaking the statute, then the fraction of those presented should indicate the relative proportion of men and women in the wage labor force. Simon Penn summarized the numbers of male and female workers at a variety of locations in the years 1352 to 1360. Overall nearly 30 percent of 818 workers presented for taking excessive wages were women. If there were equal numbers of men and women in the population this implies 41 percent of women in the medieval period were active in the labor force. Table 2 suggests that 55 percent of women in 1851 were active at least part time in the labor force. But the number of women working at any given time was more likely around 40 percent, given the relatively low earnings of married women. If the chances of running afoul of the Statute of Labourers depended on the activity level also, then it is quite possible that these prosecution records are the result of as high a level of activity by medieval women in wage labor as by women in the nineteenth century.

THE INDUSTRIOUS REVOLUTION?

Although the evidence presented above is tentative and to some degree contradictory, we see that on balance there is little sign of an industrious revolution of any consequence either in the years 1750 to 1800 as favored by Voth nor in the years 1600 to 1750 as favored by de Vries. Male threshers did not change their work rates in either of these periods, and although sawyers may have seen an increase in feet sawed per day from 1750 to 1800 there are few observations in this period. The work year of those regularly employed on farms seems to have been close to 300 days even in the eighteenth century. In the sixteenth and seventeenth century the wage assessments suggest there may have been a work year of only around 260 days, but when we look at food consumption in the years before 1602 compared to the nineteenth century it appears as though even medieval workers must typically have worked a full year. For women and children the evidence is fragmentary but suggests that any rise in wage labor input would be a small fraction of the total labor inputs in 1851.

The existence of a preindustrial industrious revolution thus is at best an open question. Indeed on balance the evidence seems to suggest that even in the Middle Ages labor input per person in England was at high levels. The fabled medieval world of laughter and leisure may turn out to have been instead a more familiar landscape of routine and drudgery.

[23] Penn, "Female Wage Earners."

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