Tracking the agricultural revolution in England

By ROBERT C. ALLEN

The timing of the agricultural revolution in England is still debated despite a century of research.1 Before 1960, the standard view assigned the revolution to the late eighteenth and early nineteenth centuries—during the period of parliamentary enclosures, which were seen as its cause.2 Prominent revisionist historians such as Havinden, Jones, and Kerridge, however, have argued that output and productivity rose significantly in the sixteenth or seventeenth century,3 and recently the revisionist view has been reformulated and extended by Allen and by Clark.4 Overton, however, has now reaffirmed the earlier faith.5 This article evaluates—and rejects—the evidence for Overton’s counter revisionism and offers new evidence that shows there were two agricultural revolutions marked by rising output and productivity. The first preceded the parliamentary enclosures and was accomplished by small-scale farmers in the open fields, while the second occurred in the first half of the nineteenth century. The second half of the eighteenth century—the main period of parliamentary enclosures—was remarkable for its stagnation.

Dating the agricultural revolution matters for two reasons, and these need to be kept in mind in assessing the evidence. The first is the relationship between rural institutions and agricultural modernization. Eighteenth-century commentators such as Arthur Young believed that agricultural improvement depended on enclosures and the shift to large-scale farms, and this remains a serious and contentious claim. The second reason is the relationship between the agricultural and industrial revolutions. Did the agricultural revolution precede the industrial revolution or was it coincident with it? Were fluctuations in agricultural output and productivity responsible for the slow pace of economic expansion between 1760 and 1815 and its acceleration thereafter?6 Only by dating the agricultural revolution can these questions be answered.

1 Research for this article was financed by a grant from the Social Sciences and Humanities Research Council of Canada for which I am grateful. I thank Peter Lindert for supplying me with the spreadsheets used in Clark et al., ‘British food puzzle’. Without implicating them in the conclusions, I thank Patrick O’Brien, Cormac Ó Gráda, and Gilles Postel-Vinay for comments on an earlier draft.
2 Ernle, English farming.
4 Allen, Enclosure; idem, ‘Agriculture’; Clark, ‘Agriculture’; idem, ‘Commons sense’; idem, ‘Renting’.
5 Overton, ‘Re-establishing’; idem, Agricultural revolution.

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Every generation rewrites history, and the treatment of the agricultural revolution is no exception. Since 1990, the cycle has been repeated with the appearance of new works advancing radically different views on the timing of the agricultural revolution and its relation to the parliamentary enclosure movement. The first of these was *Enclosure and the yeoman*, which reformulated the revisionist approach in a study focusing on the south midlands.\(^7\) This study argued that much of the productivity growth that occurred in England between the middle ages and the nineteenth century took place before the mid-eighteenth century, that small-scale, open field farmers accomplished much of this advance, that the middle and end of the eighteenth century (the ‘heroic’ phase of the old interpretation) was notable for its lack of output and productivity growth, and that the innovations (clover, turnips, New Leicester sheep, convertible husbandry) of the eighteenth century made only a scant contribution to productivity growth. Growth in output and in productivity were in fact slow in the second half of the eighteenth century but accelerated notably in the first half of the nineteenth. This view sees the industrial revolution as the result of a long, prior phase of agricultural expansion, and suggests that one reason for the slow economic growth in the early phases of the industrial revolution was the stagnation in agricultural output and productivity in the second half of the eighteenth century. The acceleration of agricultural output after 1800 was one reason for the pick-up in economic growth after 1815.

Clark has also advanced revisionist arguments based on a large sample of rents culled from the reports of the Charity Commission.\(^8\) He too finds, on average, that enclosure made little contribution to productivity growth and that the eighteenth century and the first half of the nineteenth witnessed little advance in farming efficiency. Indeed, he has gone so far as to suggest that ‘the “agricultural revolution” may simply be one revolution too many for English history to bear’.\(^9\)

In direct contrast, Overton has challenged the revisionist literature of the past 30 years including the views of Clark and, in particular, the formulation of Allen. According to Overton, ‘the agricultural revolution did not get underway until the eighteenth century’—the late eighteenth century, in particular: ‘the years from c. 1750 to c. 1850 witnessed unprecedented changes in output and productivity in English agriculture, which warrant appellation of the term “revolution”’. While he does not believe that enclosure was an absolute prerequisite to innovation, he claims that it ‘accelerated the process dramatically’. As Overton noted, this ‘verdict . . . echoes the views of an earlier generation of historians’, but he claims to have established the old view on reliable, modern evidence that overturns the findings of revisionist historians.\(^10\)

There is, indeed, much new evidence to consider. Since the 1960s,

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\(^7\) Allen, *Enclosure*.

\(^8\) Clark, ‘Agriculture’; *idem*, ‘Commons sense’; *idem*, ‘Renting’.


differences in the methods used by open and enclosed farmers have been established and used to compare the efficiency of the two agrarian systems. Any assessment of enclosure must come to terms with this material. Beyond that, however, an important way in which agricultural history progressed in the past 30 years has been by developing new methods to infer changes in output and productivity from information originally compiled for other purposes. Overton's own imaginative use of probate inventories to infer crop yields is an important case in point, as are McCloskey's application of rent theory to the problem of productivity measurement, and Crafts's use of demand theory to measure output change. The indirectness of all these methods—Overton's included—means that they make some theoretical assumptions, which are always debatable. In such a situation, the historian must examine all the approaches to measuring output and efficiency. The correct procedure is not to plump for one and dismiss the others, but to use them all in concert, testing the conclusions of one against the others. This article examines the new methods used by agricultural historians and shows that they support a revisionist view of English agricultural history.

I

The growth of agricultural output was an important feature of the agricultural revolution. While most revisionists believe that output grew substantially between the sixteenth century and the first half of the eighteenth, Overton believes that the expansion in output did not really get under way until after c.1750. If he were right, then the views of earlier historians such as Ernle would be vindicated. But, in fact, the evidence points strongly against Overton's counter revisionism.

Overton's conviction that the agricultural revolution did not begin until the mid-eighteenth century is, indeed, contradicted by his own estimates of agricultural production. These show output increasing by a factor of 2.14 between 1520 and 1651. That significant expansion was then followed by virtual stagnation with output rising by only 13 per cent from 1651 to 1741. The agricultural revolution that Overton is promoting began in the mid-eighteenth century as farm production, by his figures, jumped 39 per cent between 1741 and 1801. Expansion continued in the first half of the nineteenth century with a further 71 per cent leap in agricultural production from 1801 to 1851. Clearly, Kerridge and other proponents of an early agricultural revolution can take much comfort from these figures since the rise in output between 1520 and 1651 was almost as great as the 2.39-fold increase that Overton credits to the 1741-1851 period.

The matter needs to be explored further, however, because Overton's output estimates do not accurately chart the evolution of farm production.

11 Turner, 'Agricultural productivity'; *idem*, 'English open fields'; Yelling, *Common field*.
12 Overton, 'Estimating'; McCloskey, 'Enclosure'; Crafts, 'English economic growth'.
13 Overton, *Agricultural revolution*, p. 75.

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His estimates for the whole period 1520-1850 assume that consumption per head of agricultural products was constant, so that agricultural production grew at the same rate as population (what he calls ‘the population method’). In fact, however, consumption per caput was not a constant—it depended on income and the price of agricultural goods relative to other items purchased by consumers, as Crafts first pointed out, and the survey of nineteenth-century budgets undertaken by Clark and his co-authors makes abundantly clear.

None the less, Overton relies on the population method since he believes that it is the only one that ‘may be taken back before 1700’. Fortunately, however, the ‘demand equation method’, as developed by Jackson, can be applied to the full period 1520-1850. Agricultural output growth can thus be estimated without Overton’s assumption of constant food consumption per caput. The result is a view of the agricultural revolution very different from that proposed by Overton.

Jackson, following Crafts, applied the ‘demand equation method’ in a rate of change form. The logic of the procedure is clarified, however, by dealing with the demand curve itself rather than its derivative. Let the demand curve for agricultural products be:

\[ Q = a p^e i^g m^b N \]  

where \( Q \) is the volume of agricultural consumption, \( p \) is its nominal price, \( i \) is nominal income per head, \( m \) is the nominal price of other consumer goods, and \( N \) is the population. The own price, income, and cross-price elasticities of demand are \( e, g, \) and \( b \). The constant \( a \) can be arbitrarily chosen to make the index \( Q \) equal to one for whatever year is convenient. In this specification, the term \( a p^e i^g m^b \) is consumption per caput, so total consumption equals consumption per caput multiplied by the population, and consumption per caput is a function of income and prices—not a constant.

Application of equation (1) requires values for the elasticities \( e, g, \) and \( b \). They cannot be chosen arbitrarily. If equation (1) is to be consistent with consumer theory, then the elasticities must sum to zero:

\[ e + g + b = 0 \]

In that case, doubling income and all prices has no effect on demand.

The last statement means that demand depends on real income and real prices. In light of equation (2), \( p, i, \) and \( m \) in equation (1) can all be divided by the same number without changing \( Q \). Letting that common divisor be \( C \), a consumer price index, equation (1) becomes:

\[ Q = a P^e I^g M^b N \]

14 The difference between consumption and production is bridged by an allowance for the trade balance in agricultural products.


17 Jackson, ‘Growth’.

18 Ibid; Crafts, ‘English economic growth’.

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where \( P \) is the real price of agricultural products, \( I \) is real income per head, and \( M \) is the real price of other consumer goods.\(^{19}\)

It should be noted that Overton's population method is a special case of equation (3). If consumption per caput were independent of income and prices, then \( e, g, \) and \( b \) would all equal zero and equation (3) would reduce to

\[
Q = aN
\]

(4)

where output is a constant multiple of population. Thus, Overton’s population method does not make fewer assumptions than the ‘demand equation curve’ method; it just makes different assumptions, which happen to be less plausible.

Two sources of information can be used to determine the elasticities—studies of demand in twentieth-century developing economies and nineteenth-century English budget data. Fortunately, they concur. The budget studies show that the income elasticity of demand for food \( (g) \) was about 0.6 in England during the industrial revolution as in other countries at a similar level of income.\(^{20}\) Recently, however, Clark and his co-authors have emphasized that the overall income elasticity was probably less than 0.6 since the budget studies do not include high-income consumers whose demand was less elastic and since urbanization resulted in changed consumption patterns.\(^{21}\) Perhaps for that reason, Crafts assumed a value of 0.5 for the income elasticity of demand for agricultural goods,\(^{22}\) and Jackson recommended that figure as the most likely value, although both recognized that there was a range of possibilities. Their lead is followed here and \( g \) is taken to be 0.5. Also, as in their work, it is assumed that the cross-price elasticity \( (b) \) was positive, but small—of the order of 0.1, as in developing countries. These assumptions imply that the own price elasticity of demand for agricultural goods \( (e) \) was \(-0.6\) in light of equation (2). Experiments with other values show that the timing of the agricultural revolution was invariant to plausible changes in the elasticities although the exact magnitudes of output increases varied somewhat with the values.

Application of equation (1) requires time series of \( p, i, m, C, \) and \( N \). The population \( N \) is from Wrigley and Schofield.\(^{23}\) Following Jackson, the price indices for agricultural and manufactured goods \( (p \) and \( m) \) for 1660-1820 are from O’Brien.\(^{24}\) These series were extended back to 1520.

\(^{19}\) Differentiation of equation (3) leads to rate of change equations slightly different from those used by Crafts and by Jackson. The term representing \( M \) is absent from their equations, and \( P \), the real price of farm products, is taken to equal \( p/m \) rather than \( p/C \). The historical implications of this difference are not great.

\(^{20}\) Crafts, British economic growth; Clark et al., ‘British food puzzle’, pp. 224-5.

\(^{21}\) Ibid., pp. 232-3.


\(^{23}\) Wrigley and Schofield, Population history, pp. 531-5. These estimates begin in 1541. For the earlier years, the estimate for 1520 given in Wrigley, ‘Urban growth’, p. 688, was adopted and values for the intervening years were interpolated assuming a constant compound growth rate from 1520 to 1541.

using Bowden's national series for all agricultural and industrial prices\textsuperscript{25} and forward to 1850 using the agricultural and industrial components of the Rousseau price index.\textsuperscript{26}

The consumer price index C is weighted in terms of the spending pattern of a low-income consumer. To verify its representativeness, this index was compared with Feinstein's consumer price index for 1770-1850, and the fit was extremely close.\textsuperscript{27}

The choice of a variable to measure income raises several considerations. Consumers' disposable income is the relevant concept. While landlords and capitalists received a large proportion of the national income, they comprised a small fraction of the population and ate a small fraction of the UK's food, so wages are the relevant measure of consumer income. There were two ways by which average wage income could rise—the wage in each occupation could rise or people could move from low- to high-wage jobs—and the wage index should reflect both possibilities. This can be ensured by computing a weighted average of nominal wages in all occupations (where the weights change each year and equal the share of the employed population in the occupation) and then deflating the average with the consumer price index. Feinstein has attempted this task for the period beginning in 1770, and his index is used for 1770-1850.\textsuperscript{28} For earlier years, the Feinstein index was extended back with a weighted average of five nominal wage series: the average daily earnings of craftsmen and of labourers in London, of their counterparts in small towns in southern England, and of men in agriculture.\textsuperscript{29} For 1770-1815, this index closely tracks Feinstein's more broadly based index, although they diverge thereafter.\textsuperscript{30}

The demand equation method is implemented by substituting the various parameters and time series into equation (3) and calculating $Q$, which is the level of consumption that cleared the market. To go from $Q$ to production, two adjustments must be made as Clark and his co-authors have recently emphasized\textsuperscript{31}—the trade balance in agricultural

\textsuperscript{25}Bowden, 'Statistical appendix', pp. 846-50, 862; \textit{idem}, 'Statistics', pp. 847-9, 856. Decennial averages are given for the industrial series and have been applied to every year in the decade. Industrial prices did not fluctuate much from year to year.

\textsuperscript{26}Mitchell and Deane, \textit{Abstract}, pp. 471-2.

\textsuperscript{27}The long-term index is explained in Allen, \textit{Enclosure}, pp. 321-6. Both it and the index in Feinstein, 'Pessimism', pp. 652-3, are included in a spreadsheet available on the internet and accompanying the discussion paper version of this article. See appx. II.

\textsuperscript{28}As reported in Feinstein, 'Pessimism', pp. 652-3.

\textsuperscript{29}London wages are from Schwarz, 'Standard of living', Boulton, 'Wage labour', and Rappaport, \textit{Worlds}, pp. 403-7; the southern building wages are from Phelps Brown and Hopkins, 'Seven centuries', and the series for men in agriculture is described in Allen, \textit{Enclosure}, p. 330. Weighting proceeded in three stages. First, the wages of labourers and craftsmen were averaged for both London and southern England on the assumption that half of the population in each region received the labourer's wage and half received the craftsman's wage, thereby reducing the total number of wage series to three. Second, the proportions of London, other urban areas, and rural areas were worked out and proportions of people in the three regions were calculated for the benchmark years shown in Wrigley, 'Urban growth', tab. 4. De Vries, \textit{European urbanization}, and Bairoch et al., \textit{La population} were consulted on this. Third, values of these proportions for non-benchmark years were interpolated. These proportions were the weights used to compute the national average wage.

\textsuperscript{30}These indices are available as described in appx. II.

\textsuperscript{31}Clark et al., 'British food puzzle'.

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products must be netted out and the trade mark-up (the ratio of retail sales to farm supply) must be deducted as follows:

\[ Y = sQ/t \]

where \( Y \) is agricultural production, \( s \) is the ratio of agricultural production to total agricultural supply (English and Welsh production plus net imports), and \( t \) is the ratio of retail sales to agricultural supply.\(^{32}\) These adjustments have been made throughout, but it is only the adjustment for the trade balance after 1800 that has an appreciable effect on the results.

Jackson demonstrated a sharp break in the growth of agricultural production \( c.1740 \), and that break is maintained in the present analysis, which also shows a second break in 1800. Hence, the history of agricultural output should be divided into three periods.

![Figure 1. The first agricultural revolution: index of farm output, 1520-1739](image)

The first period extends from 1520 to 1739 (figure 1). Farm production doubled during that period. The agricultural revolution that Kerridge, Jones, and other revisionists have discussed is apparent in the figure. The second period lasts from 1740 to 1800. In those years, farm production

\(^{32}\) For the benchmark years 1695 and 1800, \( s \) and \( t \) were taken from Clark et al., ‘British food puzzle’, p. 220. These figures apply to England and Wales. Clark et al. also present 1850 values for the UK. Values for England and Wales differ from the UK values since England and Wales were food importers while Ireland was a food exporter. Peter Lindert kindly made available to me the spreadsheets for Clark, Huberman, and Lindert’s calculations, and the UK value for 1850 was divided into values for Ireland and Great Britain, the latter being as close to the values for England and Wales as one can get. Values for the intervening years were interpolated, and the 1695 values were used for earlier years. In addition, \( s \) was adjusted slightly for fluctuations in the food trade balance before 1800 as shown in Overton, Agricultural revolution, p. 75.

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increased by only 10 per cent (figure 2). The period of parliamentary enclosures is remarkable for the negligible growth in agricultural output. The third period runs from 1800 to 1850. In that period, production increased by about 65 per cent (figure 2). Yields rose and progress was widespread. This period of advance was short-lived, however, for the growth of farm output and productivity ground to a halt after mid-century.33

Figure 2. The second agricultural revolution: index of farm output, 1740-1850

The 65 per cent increase in output for 1800-50 implied by equation (5) is not much above output estimates based on likely—but often speculative—values for cropped acreage, yields, livestock numbers, and productivity. Such direct calculations suggest an increase in output somewhat above 50 per cent.34 Earlier applications of the demand curve method suggested much higher rates of output growth, and the discrepancy between those and calculations based on cropping, yields, and so on, gave rise to the ‘British food puzzle’ of Clark and his co-authors. The gap between the estimates has been largely eliminated, first by using Feinstein’s consumer price index instead of the Lindert-Williamson index, and secondly by making the adjustments for retail mark-ups and international trade called for by Clark and his co-authors.

The new estimates of agricultural production and consumption have important implications for living standards from 1520 to 1850. Consumption of agricultural goods per head fell in the sixteenth and seventeenth centuries and then rebounded, but the level reached in the early eight-

eenth century was no higher than that of the sixteenth. In the second half of the eighteenth century, food consumption per person fell again, reaching its nadir during the Napoleonic Wars. In terms of food consumption, the idea of absolute immiseration during the early industrial revolution was no myth. English workers were not getting extra food from the parliamentary enclosures and farm amalgamations of the second half of the eighteenth century. Food consumption per person did jump in the second quarter of the nineteenth century, but it did not exceed sixteenth-century levels until the very end of the period. The output of English farms failed to keep pace with population growth. It was international trade, not rising farm productivity, that fed the expanding British population after 1800.

II

The concept of agricultural revolution does not mean simply an increase in output—it also implies an increase in productivity. Estimates of outputs and the inputs used by farmers in the south midlands between the late middle ages and the nineteenth century imply substantial productivity growth before 1700 and stagnation in the eighteenth century.\(^{35}\) Rather than extend those calculations further—an exercise that would involve relating the output indices in figures 1 and 2 to total input indices—McCloskey's method of real rents will be used to track the growth in productivity.\(^{36}\) This procedure has become a widely used tool to track agricultural revolutions.\(^{37}\)

The basic idea underlying the real rent approach is that higher productivity was manifest as either greater output per acre or lower cost per acre. The difference between the two is surplus per acre, and as productivity increased so the surplus rose. How can surplus per acre be tracked? The real rent approach appeals to Ricardo's theory of rent, which implies that rent equalled surplus (less any taxes on land). This is an extreme assumption since estates varied greatly in their leasing policies and since the comparison of rents with calculations of Ricardian surplus often shows big gaps between the two.\(^{38}\) The real rent approach cannot be used without assuming that these discrepancies cancel each other out.

According to this approach, movements in the rent of land would reveal the pattern of productivity change in agriculture, if the prices of farm products and inputs were constant. Since they did change and since they also influenced the rent a farmer could pay, their effects must be removed from the rent series by deflating it with an index of farm product and input prices. The index used here aggregates the prices of nine products (wheat, barley, oats, beans, wool, beef, mutton, pork, and

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\(^{35}\) Allen, *Enclosure*, p. 228.

\(^{36}\) McCloskey, ‘Enclosure’.


cheese) and six inputs (labour, wethers, bullocks, cows, horses, and pigs). The weights are ratios of revenues or the costs of these items to farm surplus. Changes in real rent, thus defined, indicate changes in productivity.

![Graph showing five-year moving average of real rent per acre in the south midlands from 1500 to 1739.](image)

**Figure 3. Rent deflated to indicate TFP: south midlands, 1500-1739**

What does the real rent approach reveal about the English agricultural revolution? The method points to a periodization similar to that already established for output: a pre-1740 agricultural revolution, stagnation for the rest of the eighteenth century, and a post-1800 surge in productivity. Figure 3 shows a five-year moving average of real rent per acre in the south midlands from 1500 to 1739. The curve rises over the whole period, as did the index of agricultural output. This supports the case that an agricultural revolution occurred before the parliamentary enclosures.

Did open field farmers contribute to the efficiency growth shown in figure 3 or were they a 'bar to improvement' as the earlier historians maintained? To investigate this point, figure 4 plots real rent in the open

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39 The index used here is explained in Allen, *Enclosure*, pp. 327-32. See, in particular, the discussion of real rents on p. 332. The index is available as indicated in appx. II.

40 The real rent series is more erratic than that for output since rents did not adjust instantaneously to price changes. For example, the big jump in rents in the late sixteenth century reflects a lag in rent increases during a period of massive inflation. Towards the end of the sixteenth century, however, landlords and tenants had become accustomed to inflated prices and these were built into tenancy agreements.

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fields of the south midlands. Real rent rose there as sharply as it did in the region as a whole. This confirms that open field farmers participated in the pre-1740 agricultural revolution. Indeed, productivity growth in the south midlands would have been very much lower without the contribution of open field farmers since they cultivated such a large share of the land.

Figure 4. *Real open field rent, south midlands, 1500-1739*

The study of real rents also confirms the patterns previously revealed for the eighteenth century (figure 5). In the south midlands real rent stagnated from 1740 to the Napoleonic Wars, and rose to record levels thereafter. There was, thus, an eighteenth-century pause in productivity growth and a nineteenth-century surge that paralleled the movements in output.

It is desirable to establish this conclusion using a national, rather than a regional, rent index, and the recent work of Turner, Beckett, and Afton (hereafter TBA) opens that possibility. They have ransacked estate histories and archival collections to construct the first national rent series covering the eighteenth century. Their estimate of the average rent received per acre for England as a whole has been deflated for 1740-1850 (see figure 6). As with the south midlands, the evidence of rent indicates a stagnation in productivity growth over the last 60 years of

41 Real rent rose less rapidly in the heavy arable district, which was the smallest district in the south midlands. This finding is consistent with the relatively greater boost that parliamentary enclosure gave to productivity in this district.

Figure 5. Rent deflated to indicate TFP: south midlands, 1740-1850

Figure 6. Rent deflated to indicate TFP: TBA rent series, 1740-1850
the eighteenth century and renewed productivity advance during the first half of the nineteenth. Overton's eighteenth-century agricultural revolution is nowhere to be seen.

Clark has recently criticized the TBA rent index and offered his own, based on the reports of the Charity Commission. From these reports, Clark abstracted about 20,000 rent quotations covering the eighteenth and nineteenth centuries. He has used these rents to measure both the evolution of rent and the rent gain at enclosure. A virtue of these data is that they originate from sources scattered over the whole country and so may provide better national coverage than the TBA data for the early eighteenth century when the index is based on only a few sources.

Clark's data also have limitations, however. First, about 93 per cent of the observations pertain to holdings of less than 10 acres, which were rented at considerably higher values than the larger properties. The values shown in Clark's graph of the average rent of properties greater than 20 acres—about 10s. per acre in the eighteenth century and 25s. in the first half of the nineteenth—are of the same order of magnitude as rents in the south midlands, but may overstate rents for the whole country. In any event, the per acre values of the small properties were twice as high, and so do not indicate the values of farms or farmland. Why small properties commanded such high values has never been adequately explained, and, consequently, conclusions about the history of rent or the effect of enclosure on rent can only be based on the much smaller sample of large properties.

Second, many factors besides enclosure affected rents, as indicated by the low value of \( R^2 \) (about 0.3) in Clark's regressions. These factors included estate management policies and geographical factors. While he is undoubtedly right that on average enclosure made little contribution to productivity growth, his data are compatible with enclosure's having been important in some areas. To explore that possibility, the Charity Commission sample would have to be related to geographical variables to identify agricultural regions where rent increases were large. The basis in farming practice could then be explored, as could peculiarities in the rental market. The new methods, such as the study of real rent, are powerful tools. For them to be scalpels rather than sledge hammers, however, they need to be used in conjunction with each other and with the approaches of more traditional historians.

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43 Clark, 'Commons sense'; *idem*, 'Renting'.
44 There are some quotations for earlier centuries but these data are much thinner, especially for holdings over 20 acres, which are the relevant ones for gauging the value of agricultural land. Since most farm land was owned by great estates and was let in farms of more than 20 acres, the test for the reliability of the Charity Commission data is whether they replicate the rents charged by large landowners.
45 Turner et al., *Agricultural rent*, p. 57, n. 18; Turner et al., 'Renting'.
46 Clark, 'Commons sense', p. 88.
48 Turner et al., *Agricultural rent*, p. 165.
49 Clark, 'Commons sense', p. 88.
50 Ibid., p. 93.

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Third, any study of historical rents raises a sample selectivity problem; namely, that the historian can observe the rent of enclosed land only if enclosure was profitable—otherwise it would not have happened, and there would be no rent to observe. In the south midlands, for instance, it was worth enclosing land suitable for pasture as early as the fifteenth century, but land whose best use was arable was, in many cases, not worth enclosing before the high prices of the Napoleonic period. As a result, the historian can find rent quotations for open field land in the pasture, heavy arable, and light arable districts throughout the early modern period, but enclosed rents can be found only for the pasture district. To measure the rent gain at enclosure, rent comparisons must be made district by district—an inquiry requiring geographical nuancing. Clark, however, has not yet taken this step, so it is not entirely clear what his comparisons indicate.

While the Charity Commission rents invite further exploration, they do suggest important conclusions about the agricultural revolution. First, the comparisons of open and enclosed rents indicate that enclosure made little contribution to productivity growth. Second, there was no growth in real rent over the eighteenth century. Overton’s agricultural revolution is therefore also invisible in Clark’s reconstruction of English agricultural productivity.

III

Crop yields have been a particularly controversial indicator of productivity change. In view of the estimates just given of growth in output and in total factor productivity, it would be surprising if yields had not increased between the sixteenth century and c.1740.

The situation at the beginning and end of the period is reasonably clear. In round numbers, the yield of wheat during the middle ages was 10 bushels per acre throughout most of England. Norfolk was an exception where yields of perhaps 20 bushels were sometimes reaped. These high yields were achieved by sowing twice as much seed as elsewhere; Norfolk farmers, in other words, had not pushed the yield-seed ratio above the standard of other counties. Around 1800, several large-scale surveys show that the yield of wheat was 20-22 bushels per acre across England. Yields had doubled in most places. There was progress even in Norfolk. While yields there were on a par with the medieval maximum, the sowing rate had been cut to normal levels. Norfolk farmers had improved the yield-seed ratio to the same degree as other English farmers had. A similar pattern of progress characterized the other grains as well.

Had enclosure caused this rise in yields? For wheat, the answer is clearly no. Eighteenth- and early nineteenth-century survey data show that yields in enclosed villages were usually greater than those in open villages, but the enclosure increment was small compared with the rise in yields from the late middle ages to the nineteenth century. Open field

51 Campbell, ‘Arable productivity’; idem, ‘Agricultural progress’. 

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villages had accomplished most of the rise in wheat yields. Enclosure played a bigger role in the cases of barley and oats, for the enclosure increment was larger for these grains. Even so, however, yields of these grains in open field villages had increased significantly since the medieval period.52

If parliamentary enclosures were not mainly responsible for the yield increases, when did such increases occur and were they related to other changes in farm organization? Answering these questions has proved difficult, however, because probate inventories, which are available in usable form from the late sixteenth century through to the 1730s, are the principal source, and their interpretation is anything but straightforward. Oxfordshire inventories showed that wheat yields rose in the seventeenth and early eighteenth centuries,53 that is, before c.1740 when growth in output flagged. Barley yields also rose in that period, but the Oxfordshire inventories indicate they had not reached the levels of c.1800 by c.1740.

Table 1. Wheat yields in probate inventory studies (bushels per acre)

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<th>Oxon.</th>
<th>Norfolk/ Suffolk</th>
<th>Lincs.</th>
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<tbody>
<tr>
<td>16th cent.</td>
<td>15.0</td>
<td>11.4</td>
<td>10.6</td>
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<tr>
<td>18th cent.</td>
<td>21.5</td>
<td>19.2</td>
<td>18.7</td>
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<tr>
<td>c.1800</td>
<td>22.0</td>
<td>22-23</td>
<td>21-24</td>
</tr>
</tbody>
</table>


In contrast, Overton claims that yields rose after 1750. However, Overton's own studies support an interpretation of yields that is similar to the pattern in Oxfordshire (see table 1). In Norfolk and Suffolk, the yield of wheat rose 68 per cent between 1584-99 and 1710-39, but only a further 17 per cent from then until c.1800. In Lincolnshire, the advance between 1550-76 and 1725-49 was 76 per cent, but over the rest of the eighteenth century, the yield increase was only 20 per cent. On Overton's figures, therefore, the agricultural revolution occurred between 1550 and 1740 rather than in the period of parliamentary enclosures, and he endorses this conclusion, albeit in a backhanded way, when he writes, 'it was not until the early to mid-eighteenth century that wheat yields were ... around 18-20 bushels per acre'.54

The history of barley yields also shows large advances before the early eighteenth century (see table 2), but much progress was made after that

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52 Allen, Enclosure, pp. 130-49.
53 Idem, 'Inferring yields'.
54 Overton, 'Re-establishing the agricultural revolution', p. 8. The words 'breaking through the medieval ceiling of' have been removed from the middle of this citation. As noted in the text, it was only in Norfolk that English farmers achieved yields of 18-20 bushels in the middle ages, and they reached that level only with exceptionally high sowing rates.

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date as well. In Norfolk and Suffolk, barley yields rose over 70 per cent before the early eighteenth century. In Lincolnshire, there was no yield increase at this time, although the yields in that county for the beginning of the period are unaccountably high so the early eighteenth-century figures may well indicate real advance over lower medieval levels. In all counties, barley yields grew more in the eighteenth century than did wheat yields, a fact which tallies with the evidence of yield change during enclosure, as previously noted.

<table>
<thead>
<tr>
<th>Year</th>
<th>Oxon.</th>
<th>Norfolk/Suffolk</th>
<th>Lincs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>16th cent.</td>
<td>12.9</td>
<td>12.2</td>
<td>19.0</td>
</tr>
<tr>
<td>18th cent.</td>
<td>18.3</td>
<td>20.8</td>
<td>18.5</td>
</tr>
<tr>
<td>c.1800</td>
<td>30.0</td>
<td>32–34</td>
<td>31–34</td>
</tr>
</tbody>
</table>

Sources: as tab. 1.

Why, then, does Overton insist that the great advance in yields occurred only after 1750? There are three aspects to this question. First, Overton has tried to dismiss the findings derived from Oxfordshire yields on the grounds, first, that the sample was too small, and, secondly, that the method of analysis overstated yields. However, the similarity between Overton’s findings for East Anglia and the Oxfordshire yields shows that these considerations are irrelevant. That his large samples point to the same conclusion as the smaller Oxfordshire study is a useful demonstration of the power of statistical sampling theory. That the yields are so similar shows that the debates about method do not have large historical implications. The second issue, of somewhat more moment, is the definition of the time frame. Given that major concerns about the agricultural revolution include its relationship to the industrial revolution and to the parliamentary enclosure movement, the key question is whether output or productivity rose before or after c.1750. Overton, however, has been inclined to choose 1700 as the dividing point because of his rather literal reading of the contrast between the seventeenth-century yeoman’s revolution and the eighteenth-century landlord’s revolution. By choosing 1700, Overton is able to brush aside the yield increases of the first half of the eighteenth century in his assessment of agrarian institutions and the role of agriculture in economic development. However, 1750 is the

56 For the record, Overton’s eighteenth-century estimates are probably too low since the harvesting costs used in his calculations do not include the value of the farmer’s time or the capital costs of horses and equipment, and exclude altogether some of the tasks involved. None the less, the important conclusion—that yields rose substantially between the sixteenth century and the early eighteenth—comes through clearly in Overton’s own findings.
57 Allen, Enclosure, p. 21.
historically relevant turning point, and yields—like output and productivity—rose decisively before that date.

Finally, there is a weighting issue. Wheat yields rose more than those of barley or oats. How should they be combined? Overton weights them by cropped acreage which puts undue emphasis on barley and oats whose yields grew least rapidly. The correct weights are shares of net farm revenue. Reliable estimates of the total production of the various crops are not possible before the information collected in the 1801 crop returns. Around 1800, the value of wheat was £26 million, rye was £2 million, barley was £10 million, and oats was £2 million.58 Hence, wheat dominates the history of crop yields, and the history of wheat shows the importance of the pre-1750 agricultural revolution.

The evidence of probate inventories thus substantiates the conclusions advanced earlier. There was an agricultural revolution before the mid-eighteenth century, and it accounted for much of the output growth that occurred in England before the industrial revolution. The output increases attributable to enclosures and farm amalgamations in the eighteenth century were of secondary importance.

IV

Probate inventories are a promising source for understanding why yields increased, but, to date, the results have been negative rather than positive. Since the yield derived from an inventory applied to an individual farm and since the historian knows other characteristics of the farm, multiple regression analysis can be used to correlate yields with other characteristics, both social and technological.

The main social characteristic investigated so far is farm size. This is of great importance since so many prominent commentators have claimed that large farms led to high yields. On this question, however, there is agreement that yields were independent of farm size.59 Inventories can also be used to investigate the effect of crop choice on yields. In Oxfordshire, yields were independent of cropping patterns—in particular, the extent of legume or clover cultivation.60 These findings challenge the view that rising yields were the result of the wider cultivation of nitrogen fixing crops.61

Overton has also explored these questions with his East Anglian data, although, idiosyncratically, he avoids multivariate models and standard statistical tests.62 Instead, he reports a series of one-way comparisons—for example, the yield of wheat on farms growing turnips is compared to the yield on other farms—without stratifying the data to control for other important variables such as soil type, livestock density, cultivation

58 These figures are net of on-farm deductions for seed and fodder. Average prices for 1798-1802 are derived from John, ‘Statistical appendix’, and production figures from Holderness, ‘Prices’, p. 145.
of other crops, and so forth. When wheat yields on turnip-growing farms are compared with yields on other farms, is the difference in yields the result of turnip cultivation or of something else that happened to have been correlated with it? Overton's method precludes answers to such questions. The absence of statistical testing means that one never knows whether or not the differences in means are substantial in view of the typical fluctuation in yields from farm to farm. Nevertheless, he has also concluded that the cultivation of pulses did not raise yields. He believes he has detected a tendency for clover and turnips to raise yields, but that it is slight. His table implies that the cultivation of clover and turnips at eighteenth-century levels raised output only 1.5 bushels per acre.63 Such a small increase is easier to square with a small growth in farm output in the eighteenth century than with the large increase that Overton suggests and, further, it explains only a small fraction of the yield growth that occurred between the middle ages and the nineteenth century.

The change in farming that might have raised yields was an increase in animal numbers relative to the arable. The image of big cows manuring the fields is a classic of the English countryside, but, before it can be accepted as a theory of agricultural progress, two questions must be addressed. First, what impact did livestock numbers have on yields, and secondly, by how much did livestock densities increase? The answer to the first question is promising. A regression analysis of Oxfordshire inventories shows that an increase in 'animal density per acre' of one unit increased the yield of wheat or barley by about 5 bushels per acre, although the effect was not always statistically significant. However, the answer to the second question raises doubts about the relevance of this regression result. Despite the enthusiasm of early commentators and historians for the big herd model, livestock densities in many parts of England were stable throughout the early modern period.64 Overton's figures for Norfolk and Suffolk, for instance, show that animal density per acre increased from 0.602 to 0.709 between 1584-99 and 1700-39, for a gain of 0.107.65 Multiplying that by 5 implies that yields should have risen about half a bushel per acre (0.535 = 0.107 x 5) in that period in response to the increase in livestock numbers. Even the larger increases in livestock densities that Overton and Campbell report for mixed farms in Norfolk would have raised corn yields by only about 1.5 bushels per acre.66 Clearly, this is small compared with the rises in yields for barley and wheat shown in tables 1 and 2. Rising livestock numbers cannot explain the rise in yields that occurred before 1800.

Using probate inventories to explore the determinants of yields has undermined the traditional accounts of the English agricultural revolution. The inventories show that more cattle and new crops were not the causes of rising yields. Other factors were at work. These may have been better

63 Overton, 'Determinants of crop yields', p. 314.
64 Allen, Enclosure, p. 197; Mingay, 'East midlands', p. 102; Yelling, Common field, p. 158.
65 Overton, 'Determinants of crop yields', p. 308.
66 Overton and Campbell, 'Norfolk livestock farming'.

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seed varieties, better tillage, or something else. Solving this puzzle is an important challenge for agricultural historians.

V

Studies of demand, real rent, and probate inventories are the newest approaches to the agricultural revolution. The results of these investigations, however, must be interpreted in conjunction with the more traditional inquiries of historians, including the reconstruction of farming methods and output from abundant contemporary publications and archival sources. Frequently, these studies involve contemporaneous comparisons of farming in open and enclosed villages (cross-sectional evidence) rather than ‘before’ and ‘after’ comparisons (time series evidence). Overton has argued that cross-sectional evidence is likely to be biased and has championed the use of time series evidence instead.

There is no mystery as to why economic historians have relied on cross-sectional evidence. They use it since so much of it was generated by eighteenth- and nineteenth-century tours and surveys. Surely that material should not be ignored, especially since there is not much else available. The problem in interpreting cross-sectional data is the need to confine comparisons of open and enclosed villages to regions sharing the same natural environment, so that the effect of social organization can be separated from that of the environment.

In Enclosure and the yeoman, cross-sectional comparisons of open and enclosed farming in the south midlands illustrate the problems and promise of cross-sectional data. These comparisons were based on Parkinson's General views of Huntingdonshire and Rutland, which report the results of parish level inquiries on farming. The descriptions of the soil and methods indicate that the villages should be divided into three groups reflecting the most profitable use of the land—the pasture district, the light arable district, and the heavy arable district. In each district, new methods which raised productivity were diffusing. While enclosure often led to the more extensive use of new methods, these had little impact on output or efficiency. On light arable soils, for instance, enclosed farms modernized the management of sheep and cultivated turnips and clover to a much greater extent than open farms. There was some output and productivity gain on the sheep account, but very little increase in

67 Allen, Enclosure, pp. 206-7; Glennie, ‘Continuity and change’.
68 While time series evidence (‘before’ and ‘after’ comparisons of the same village) may seem to obviate the need to control for geography, that attraction is largely illusory. Annual fluctuations in weather, and the need to give farmers in the newly enclosed village time to find the best use of the land, mean that ‘before’ and ‘after’ become a long run of years. If productivity was rising in open field villages as well, then we must designate some open field villages as a control group to see whether the newly enclosed villages had faster productivity growth than they would otherwise have achieved. Choosing the control group, of course, raises the same questions of geography as the cross-sectional comparisons. ‘Before’ and ‘after’ comparisons thus become cross-sectional in nature because serious ‘before’ and ‘after’ work requires a panel dataset (pooled cross-sectional, time series data).
69 Allen, Enclosure, pp. 107-87.
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overall production or efficiency—a result that is not surprising in view of the evidence of probate inventories. In the pasture district, where enclosure led to the conversion of arable to grass, total output (measured in £ per acre) fell. The incentive for enclosing came from cost savings, but these enclosures also look less profitable than enclosures for pasture carried out in the sixteenth and seventeenth centuries. Only in the heavy arable district where enclosed land remained under the plough were there substantial yield increases following enclosure. These were the result of sub-surface drainage made possible by land consolidation. Only in this (the smallest) part of the south midlands did enclosure lead to stable costs and greater output, which generated the cash flow to pay the higher rent. (In other words, only here did rental markets work in the simple way assumed by those who use real rent to measure productivity change.) Even here, the gains in yield were confined to the spring crops since open field farmers were already achieving high wheat yields—an expected result in view of the evidence of probate inventories.

Overton advances a very different assessment of parliamentary enclosure. 'Enclosure accelerated the process [of agricultural improvement] dramatically.' In view of the importance of the issue, it is surprising that Overton introduces no new evidence (aside from the example of Canwick, which will be considered shortly) in support of his insistence on the productivity raising effects of enclosure. His case for the importance of enclosure rests mainly on the rise in his output index after 1750—'the major upsurge in agricultural output and productivity came after the mid-eighteenth century: this coincides with the major burst of parliamentary enclosure' and a critique of the evidence showing that enclosures did not result in much growth in productivity or output. Since the rise in Overton's output index is spurious, his case for enclosure is reduced to his critique and the example of Canwick.

The critique raises two misleading sets of issues. First, Overton dismisses the results in *Enclosure and the yeoman* as biased, since they rest on cross-sectional data rather than 'before' and 'after' comparisons. The effect of enclosure on livestock numbers is one of his examples. He cites the findings for the two arable districts in Huntingdon and Rutland. In those districts, livestock numbers were lower in enclosed villages than in open villages. He contrasts these findings with the *General report on enclosures* which says that livestock numbers fell after enclosure in some villages but rose in others. He concludes that the cross-sectional comparisons are biased since they do not show the rise.

Overton's argument, however, misses the mark because he ignores the discussion of a third natural district—that of pasture—in which livestock numbers and the allocation of land to grass were high in enclosed villages. When all the districts are considered, there is no conflict

70 Overton, 'Re-establishing', p. 20.
73 Ibid., pp. 122-5.
between cross-sectional and time series data. Both sources show that enclosure sometimes increased livestock numbers and sometimes lowered them. Overton raises a number of objections in the same vein, that suffer from the same problems.

The speed with which enclosed farmers took up new crops is the second issue that throws Overton off track. Enclosed farmers did, indeed, grow more clover and turnips than did open field farmers, and Overton thinks that means that the enclosed farmers must have produced more: 'Why did innovation take place if neither yields nor output increased?'74 There are two responses. In some cases, the innovations were adopted because they cut costs rather than raising output. More generally, however, the issue is a matter of degree. On light soils where clover, turnips, and the New Leicester sheep were introduced, there was a small rise in sheep profit, but the overall advance was puny. (As noted earlier, Overton’s probate inventories show that turnips and clover had little, if any, impact on yields.) Even where enclosure had its biggest effect on yields—on heavy clays where underdrainage was introduced—the rise in yields was only a fraction of the yield growth that took place between the middle ages and the nineteenth century. And that growth is the appropriate yardstick. By that standard, enclosure was not important for explaining the productivity growth that occurred in early modern England.

Pundits and commentators are rarely 100 per cent wrong. Enclosure did lead to visible changes in land use. Farmers made these changes because there was some efficiency gain. It does not follow, however, that the gain was large. The railway is an important parallel. While it was dramatic and, to many, epitomized nineteenth-century industrialization, its contribution to economic growth was much less than most observers imagined.75

VI

Many of the points discussed here can be illustrated with the enclosure of Canwick in Lincolnshire. Its story is the only new information about farming techniques that Overton introduces into the enclosure debate, so it is worth analysing Canwick carefully. Overton believes its history illustrates both large efficiency gains at enclosure and the superiority of the ‘before’ and ‘after’ approach. However, a careful review of the evidence shows that enclosure caused only a modest output gain in Canwick. Since that is the same conclusion supported by the cross-sectional comparisons, the history of Canwick validates their reliability.

Overton’s analysis of Canwick is based on the report of pre- and post-enclosure output prepared for the General report on enclosures by the minister of Canwick.76 Although ‘wheat yields rose by only 10 per cent’,

74 Overton, ‘Re-establishing’, p. 18.
75 ‘This was, of course, the much debated conclusion of Fogel, Railroads. For a discussion of the issues and evidence, see O’Brien, New economic history.
76 Young, General report, pp. 270-1.
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Overton was impressed that 'barley and oats yields [increased] by 40 and 78 per cent respectively'. What truly amazed him, however, were the sheep whose 'output increased by an astonishing 590 per cent' because better breeds were kept and fed with fodder crops rather than simply being folded as in the open fields.

A closer look at the figures, however, deflates any enthusiasm for the progressive role of enclosure. Sheep were but a small part of Canwick's farming. Even by the minister's own calculations, agricultural output increased only 20 per cent after enclosure. Since an increase of 20 per cent is slight by comparison with the rise in agricultural production in England from the middle ages to the nineteenth century—more than a three-fold increase on Overton's figures—enclosures such as that of Canwick were only a minor aspect of the agricultural revolution.

Table 3. Agricultural production in Canwick, before and after enclosure (£ p.a.)

<table>
<thead>
<tr>
<th></th>
<th>Open</th>
<th>Enclosed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>£1,425</td>
<td>£1,030</td>
</tr>
<tr>
<td>Barley</td>
<td>1,362</td>
<td>1,662</td>
</tr>
<tr>
<td>Cows</td>
<td>414</td>
<td>204</td>
</tr>
<tr>
<td>Bullocks (bred)</td>
<td>480</td>
<td>90</td>
</tr>
<tr>
<td>Bullocks (fed)</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Sheep (fatted)</td>
<td>0</td>
<td>390</td>
</tr>
<tr>
<td>Sheep (bred) wool</td>
<td>200</td>
<td>400</td>
</tr>
<tr>
<td>Lambs</td>
<td>0</td>
<td>200</td>
</tr>
<tr>
<td>Total</td>
<td>£3,881</td>
<td>£4,076</td>
</tr>
</tbody>
</table>

Notes and sources: Value added for the fed and fatted stock was computed by multiplying the gross outputs given in Young, General report (pp. 270-1) by the ratio of value added to sale price as suggested by Young's figures in Farmer's guide. His accounts show fatted stock increasing as follows: heifers from £3 to £5, beasts from £5 to £7, steers from £7 to £11, sheep from 12s. to 24s. See, for instance, Young, Farmer's guide, I, pp. 339, 351; II, pp. 100, 105.

Even the minister's figures exaggerate the increase, however. Suppose a farmer buys a bullock for £3, fattens it, and then sells it for £5. How much output is produced? The answer is £2—the increase in its value due to its sojourn in Canwick—but the minister set the value at £5, and Overton follows suit. This practice inflates the value of output, particularly for the post-enclosure case when fattening had become important. Table 3 replaces gross revenue with value added in computing the output of feeding and fattening operations. With the revisions, farm output rose only 5 per cent at enclosure—an inconsequential advance.

Canwick has other important lessons to teach. First, as Overton noted, the yield of wheat rose only 10 per cent when the village was enclosed. Clearly, open field farmers had accomplished most of the increase in wheat yields achieved between the late middle ages and the early nineteenth century. The performance of open field farmers in Canwick with

77 Overton, Agricultural revolution, p. 75.
the spring crops, however, was less impressive. These results are common and are the counterparts to the yield histories derived from probate inventories, which, as reviewed previously, often show high yields of wheat early in the eighteenth century but yields of barley and oats considerably lower than early nineteenth-century levels. Much of the eighteenth-century advance for those crops was made at enclosure. Secondly, turnips were planted on 15 per cent of the arable in the open fields. This is another example of the progressiveness of open field farmers. Thirdly, there were significant changes in farm practice when Canwick was enclosed. The fallow was eliminated, clover was widely cultivated, sheep husbandry was modernized, dairying reduced, and fattening of beef cattle introduced. Whatever the motive for these changes, they did not result in much extra output. Undoubtedly, there was only a small increase in total factor productivity. Canwick is a good example of the principle that enclosure could lead to impressive changes in farming practice without a large rise in output or efficiency. As Overton remarked of Canwick, ‘although merely one example it is instructive’.78

VII

Many historians writing earlier in this century had a narrow view of the agricultural revolution—when it happened and what it consisted of. They emphasized the views of the eighteenth-century improvers who were enamoured of the institutions and innovations of their own day—hence, the emphasis on the progressive role of the great estate, the importance of enclosure, and the productivity raising effects of turnips, clover, and new sheep. Arthur Young’s understandable lack of historical perspective was incorporated into historical writing where it is less forgivable. Recently, historians have placed the eighteenth century in a much longer historical context. Seen from this perspective, eighteenth-century farming looks less path breaking than it did from the saddle of Arthur Young’s horse. Despite his best efforts, Overton cannot get us back into the saddle again.

University of British Columbia


APPENDIX I: Sources of the south midlands rent series

The rent series for the south midlands and its natural districts was originally published in Allen, ‘Price’, p. 43, but detailed sources were omitted. The sources are listed here. The 1583 observations themselves are available in a data file called RENTS, attached to R. C. Allen, ‘Tracking the agricultural revolution’, UBC Dept of Economics Discussion paper No. 98-18 (Vancouver, 1998), and available at www.arts.ubc.ca/econ/hmpgalle.htm on the world wide web.

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Estate records
Bedford County Record Office
R box 797, CRT 100/25, CRT 100/34, LA 1/14-27

Bodleian Library, University of Oxford
dd. Harcourt, b. 37, dd. Harcourt, d. 32, dd. Harcourt, e. 8, dd. Harcourt, d. 23,
Ms. Top. Oxon. b. 121, Ms. Top. Oxon. c. 381, Ms. Top. Oxon. b. 210

Huntingdon Record Office
dd. M.b.10/5, dd. M.b.10/1, dd. M.b.10/6, dd. M.b.10/8, C4/2/2/13, C4/2/5/5a,
C4/2/2/13, C4/2/5/59, C4/2/6/3d, C4/2/6/8, C4/2/6/11, C4/2/2/4, C4/2/8/7

Northamptonshire Record Office
A177, A204, A205
C(A) 5737, C(A) 5739, C(A) 5740, C(A) 7492
DC(A) 211, DC(A) 306, DC(A) 444, DC(A) 3817
G. 1654, G. 1811, G. 1844
Brudenell ASR 95, Brudenell ASR 96
TB1074

Victoria County Histories
Bedford, vol. II
Cambridge, vol. V
Huntingdon, vol. II
Leicester, vols. II, V

Arthur Young’s tours
Young, *Six months’ tour*; *idem*, *Farmer’s tour*; *idem*, ‘Shropshire’; *idem*, ‘West’; *idem*, ‘Ten
days’ tour’; *idem*, ‘Month’s tour’; *idem*, ‘Minutes’.

Board of Agriculture county reports
tingdon; Priest, *Buckingham*; Vancouver, *Cambridge*.

Other works
‘Agrarian revolution’.

APPENDIX II: Price and wage series

Basic price and wage series used in this paper are available in a file called
PRICES, attached to Allen, ‘Tracking’ (see app. I) and available at
www.arts.ubc.ca/econ/dp9818.pdf on the world wide web. From left to right the series are:

1. agricultural consumption, five-year moving average;
2. agricultural production, five-year moving average;
3. consumer price index, 1500-1850, described in Allen, *Enclosure*, pp. 321-3;
4. consumer price index from Feinstein, ‘Pessimism’, pp. 652-3, rebased for comparison
   with the Allen index;
5. average wage of five groups of workers: artisans and labourers in London and in
   provincial towns in southern England and farm labourers in southern England;
6. average earnings index from Feinstein, ‘Pessimism’, pp. 652-3, rebased for comparison
   with the wage index, item 5 above;
7. price index of agricultural goods;

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8. price index of manufactured goods;
9. population;
10. average rent of land in the south midlands, shillings per acre;
11. average rent of open field land, pasture district, shillings per acre;
12. average rent of open field land, light arable district, shillings per acre;
13. average rent of open field land, heavy arable district, shillings per acre;
14. average rent, shillings per acre, from Turner et al., Agricultural rent, pp. 309-13;
15. deflator for rent to calculate agricultural TFP from Allen, Enclosure, p. 332.

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