Clark's Malthus delusion: response to 'Farming in England 1200-1800'

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3 August 2017
File: Clark EHR Response Revision v8

> Clark's claims about the scale of English agricultural output from the 1200s to the 1860s flout historical and geographical reality. His income-based estimates start with the daily real wages of adult males and assume that days worked per year were constant. Those advanced in *British economic growth* (*BEG*) make no such assumption and instead are built up from the output side. They correlate better with population trends and are consistent with an economy slowly growing and becoming richer. Clark's denial that such growth occurred, his assertion that substantially more land must have been under arable cultivation, his belief that conditions of full employment invariably prevailed in the countryside at harvest time, his concern that the wage bill would have exceeded the value of output in *BEG*, his refusal to consider the possibility that the working year was of variable length, and his assertion that output per acre must have been equalised across arable and pasture are all shown to be figments of his 'Malthus delusion'.[1]

In *A farewell to alms*, Gregory Clark advanced the view that England, along with all other pre-modern economies, was caught in an eternal Malthusian trap, in which all economic progress was ultimately absorbed by increases in population, from which it only escaped into self-sustaining growth late on in the industrialising process towards the end of the nineteenth century.[2] Since then, a growing body of evidence has shown that England, in company with a handful of other European economies, was escaping from Malthusian constraints and slowly raising national income per head well before the onset of the industrial revolution. The case in support of the latter view is set out most clearly in Broadberry, Campbell, Klein, Overton and van Leeuwen, *British economic growth 1270-1870* (henceforth *BEG*), which is why Clark now takes issue with the output-based agricultural production estimates advanced in that book and asserts, instead, the superiority of his own income-based estimates.[3] In defence of his stagnationist position, Clark asserts, first, that *BEG* overstates the growth of English agricultural output in the long term, and second, that by massively underestimating the amount of land under arable cultivation it underestimates by almost half aggregate agricultural output 'for most of the years before 1750'.[4] To these fundamental issues, Clark adds a number of

[1] The term 'Malthus delusion' is taken from the title of an earlier paper by Clark, '1381 and the Malthus delusion'. We are grateful to three anonymous referees for their comments on an earlier version of this paper.

[2] Clark, *Farewell to alms.*

[3] Broadberry and others, *British economic growth*. For corresponding estimates for Holland and some other countries see van Zanden and van Leeuwen, 'Persistent but not consistent'; Bolt and van Zanden, 'Maddison Project'.

[4] Clark, 'Growth or stagnation?', p.23.

second order criticisms, based on claims of inconsistency. This response explains why these criticisms fail.

I Clark's estimate of agricultural output

Until the advent of significant net food imports in the nineteenth century, it is reasonable to suppose that, subject to some adjustments to its composition, the output of English agriculture must more-or-less have kept pace with population. Certainly, that is the conclusion of *BEG* and it is borne out by the annual growth estimates of agricultural output and population summarised in Table 1 and graphed in Figure 1. Over the period 1300-1870 the correlation between both sets of growth rates was +0.94 while between 1270 and 1870 agricultural output and population both grew at 0.3 per cent per annum, resulting in per capita agricultural output growth over these six centuries of zero. Unsurprisingly, agricultural output growth was negative during the century or more of demographic retrenchment initiated by the Black Death, recovered to 0.48 per cent in the sixteenth century (when the population was growing at 0.63 per cent), slowed to 0.3 per cent in the seventeenth century but then accelerated to 0.7 per cent in the eighteenth century when it was increasing faster than the population. Clark may choose to characterise the resultant output growth as 'enormous' but in reality agricultural output barely kept pace with population over these six centuries.[5]

Compared with industry and services, agriculture remained the slowest growing sector both before and after 1700, in an economy with a GDP per capita growth rate of just 0.17 per cent per annum between 1270 and 1700 and 0.48 per cent between 1700 and 1870. More important were the improvements made to labour productivity in agriculture, which from 1522 to 1700 grew faster than that in industry (0.13 per cent compared to 0.07 per cent) and from 1700 to 1759 faster than that in both industry and services (0.57 per cent compared to 0.32 per cent and 0.26 per cent) and thereby allowed labour, provisions and raw materials to be released to these other more dynamic sectors upon whose growth that of the wider economy depended.[6] This is a story of slow evolution rather than rapid revolution. Clark nevertheless disbelieves that such a 'remarkable increase in output' could have occurred.[7]

Table 1 and Figure 1 about here

[5] Clark, 'Growth or stagnation?', p. 23.

[6] Broadberry and others, *British economic growth*, p. 367; Wrigley, 'Transition'.

[7] Clark, 'Growth or stagnation?', p.1.

Clark's alternative estimates of English agricultural output are derived indirectly from information on labour supply, wages and farm rents, benchmarked against absolute output levels in the late 1860s obtained from the *Agricultural returns for Great Britain* and then projected back as index numbers from there (Figure 2A). Implied growth rates (Table 1 and Figure 1) fall within a narrower range than those calculated by *BEG* and, with the conspicuous exception of the fourteenth century, tend to be slower. The fit with population growth rates is also less tight, especially during the 'golden age of labour' that followed the Black Death, when the daily real wage rates of adult males gained by more than GDP per head, and again during the 'Engels' pause' of the eighteenth century, when gains in daily real wage rates lagged behind those in GDP per head.[8] On Clark's figures, the absence of any significant output decline during the fourteenth century, when the population shrank by at least half and land began to lapse from cultivation, is one paradox; the meagreness of output growth during the eighteenth century, when the population increased by 70 per cent and most other commentators estimate that agricultural output approximately doubled, another.[9] Both paradoxes suggest that there are problems with Clark's figures.

Figure 2 about here

It can be no coincidence that these two major anomalies in Clark's agricultural output series occurred when the daily real wage rates of adult males were particularly 'unreal'.[10] Their combined effect is artificially to inflate all his pre-1800, and especially pre-1700, output estimates, with the magnitude of that inflation increasing the further back in time that he goes. This point is graphically illustrated by Figure 2B which re-indexes the Clark and the *BEG* output series against base year 1700 = 100. Clark may think that the key discrepancy between his agricultural output estimates and those presented in *BEG* occurs in the medieval period, but that is mainly an illusion created by indexing the two series against their shared end date of 1860s = 100. In fact, over the 400 years 1300-1700 annual rates of output growth according to the two series were little different: 0.11 per cent (Clark) and 0.13 per cent (*BEG*). Instead, it is after 1700 that the two series diverge most widely, with respective annual growth rates of 0.04

[8] Hatcher, 'Unreal wages'; Allen, 'Engels' pause'; Broadberry and others, *British economic growth*, pp. 258-63, 331-2. Daily real wages of adult females tracked a somewhat different course: Humphries and Weisdorf, 'Wages of women', pp. 417-19, 427-8.

[9] Holderness, 'Prices', pp. 144-7; Allen, 'Agriculture', p. 102; Crafts, *British economic growth*, p. 42; Crafts and Harley, 'Output growth', p. 715.

[10] Hatcher, 'Unreal wages'; Angeles, 'GDP'; Broadberry and others, *British economic growth*; Humphries and Weisdorf, 'Unreal wages?', 19-23.

per cent and 0.70 per cent for the eighteenth century. Retrospectively, it is from the eighteenth century that Clark's back-projection of output trends begin to go awry and this error is then further compounded by the unnatural buoyancy of his series following the Black Death.[11] The problem, therefore, is not that the pre-1700 output estimates of *BEG* are 'substantially too low' but that Clark's are substantially too high.[12] The explanation for this lies in the basis upon which his output series has been constructed.

Clark's estimates of agricultural output, like his estimates of national income, are derived from the income side and both are powerfully influenced by the daily wage-rate series that he uses.[13] For adult male wage earners, he assumes a constant 300 days worked per year, so that the daily real wage rate is multiplied by this constant figure to infer the annual earnings of male labourers. The fallacy of this assumption is highlighted in *BEG*, where it is shown that the length of the working year conceivably varied from a minimum of 165 days in the aftermath of the Black Death to a maximum of over 300 days at the height of the industrial revolution when there were strong incentives for workers to labour more 'industriously', a point recently endorsed by Humphries and Weisdorf's independent assessment of the length of the male working year.[14] By failing to allow earnings to rise in line with the lengthening of the work year, Clark seriously underestimates the growth of agricultural incomes. His estimates of agricultural output derived from the income side are therefore intrinsically flawed and those for the late-medieval period are seriously wide of the mark. He can only make them fit by claiming that almost 50 per cent more land was under arable cultivation in 1290 than the maximum of 12.75 million acres proposed by *BEG*. By so doing, he compounds the effects of unreal wage rates with unrealistic assumptions about English agricultural land use.

II Geographical and historical limits on the arable acreage in 1290

Before 1866 there are many estimates of the arable acreage but they all suffer from problems of definition, representativeness and accuracy. Thereafter the annual *Agricultural returns for Great Britain* become available. The first returns had some teething problems so *BEG* uses

[11] For the scale and duration of the post Black Death demographic decline see: Broadberry and others, *British economic growth*, pp. 13-22; Campbell, *Great Transition*, pp. 351-5.

[12] Clark, 'Growth or stagnation?', p.14.

[13] Clark, 'Macroeconomic aggregates'; Broadberry and others, *British economic growth*, pp. 248-66.

[14] Broadberry and others, *British economic growth*, pp. 263-5; Humphries and Weisdorf, 'Unreal wages?', pp. 25-7; below, p. 22.

data from the 1871 survey which show that England contained 13.83 million acres of arable land and 9.65 million acres of permanent pasture or grass plus commons, heaths, orchards, woodland and extensive amounts of low-grade mountain land.[15] Arable here is taken to mean land under all kinds of crops, including grasses under rotation as well as bare fallow. In the opinion of Gregory King, England and Wales had contained around 11 million acres of arable land in the 1690s, of which England probably accounted for just under 10 million acres.[16] Six centuries earlier the number of tenants and land holdings enumerated in the Domesday Survey of 1086 imply that the population estimated by *BEG* at approximately 1.71 million maintained around 5.5-6.0 million acres of tillage.[17] By 1290 *BEG* proposes that the arable area had expanded to 12.75 million acres but Clark considers this to be a massive underestimation and prefers instead a figure of at least 18 million acres.[18] This is more than treble the current Domesday estimate, 5.25 million acres more than the *BEG* estimate, 7 million acres more than Gregory King's estimate for England and Wales in the 1690s and 4.27 million acres more than were under the plough in 1871. So vast an area would inevitably have included much land that was marginal for arable cultivation and inferior in productivity and could only have been brought under the plough at the expense of other land uses, most obviously grassland of one sort or another. Yet maintaining so much extra land in cultivation would have required an additional 0.33 million working animals plus the breeding stock needed to reproduce them and patently could not have been at the expense of the several million acres of grassland that supported the national flock of over 10 million sheep growing wool for export.

The agronomic implications of his claim have plainly not entered Clark's calculations. On his reckoning 56 per cent of the 32.3 million acres that make up England's landmass, and 75 per cent of the country's potential agricultural area, would have been in tillage cultivation at this medieval peak in agricultural output. That circumstances of climate, topography and soils have always rendered much of the English landscape inherently unsuitable for the cultivation of crops, particularly in the hilly, cool and rainy north and west of the country, is

[15] Coppock, 'Mapping the agricultural returns'; *Agricultural returns*.

[16] Barnett, *Two tracts*, p. 35; Chartres, 'Marketing', pp. 443-4.

[17] Campbell, *English seigniorial agriculture*, pp. 386-9; Broadberry and others, *British economic growth*, pp. 6—8, 72-3. Hinton, 'Demography', p.169, claims that in Wessex 'an unquantifiable but very substantial number of people were omitted from Domesday Book', which might elevate the total population to over 2 million and the arable area to at least 7 million acres.

[18] Clark, 'Growth or stagnation?', suggests a figure of 18 million acres on p.9, but also mentions a figure of 19.4 million acres on p.3.

clearly to him beside the point. Nor is he concerned that substantial amounts of land were also needed for other purposes, specifically meadow and pasture to support and reproduce the large numbers of draught animals employed in arable cultivation and for livestock production in general, woodland for timber and the production of fuel (at a time when there was almost total reliance upon firewood for thermal energy), and forests, chases and parks for the recreational activities of the landed elite.[19] The same applies to the roles of forest law and common rights — both close to their maximum territorial extents c.1300 — as powerful institutional constraints upon the scale of arable cultivation.[20] All of this he disregards in his vain endeavour to demonstrate that agriculture's 'actual output levels must have been nearly double Broadberry et al.'s estimates in the years before 1700'.[21]

Yet the real geographical, institutional and economic constraints within which English agriculture operated cannot be ignored. Taking due account of these hard realities, *BEG* therefore proposed that:

> 'As a rule of thumb, England had a potential agricultural area of 24 million acres, divided roughly equally between arable and grass, with more tillage than pasture in the south and east and vice versa in the north and west. Even after partial substitution of temporary grass for permanent pastures, around 40 per cent of the agricultural area remained under permanent grass, … so that the country's potential arable area was at most 15 million acres, equivalent to 46 per cent of the national land area.'[22]

This is broadly consistent with a farmed area of 23.72 million acres in 1871, a figure that remained remarkably constant thereafter, and with Gregory King's earlier estimate that at the close of the seventeenth century England and Wales contained approximately 11 million acres of arable land and a roughly similar amount of grassland, plus commons, woodland, parks and forests.[23] Back in 1290 there are good reasons to believe that England actually contained more

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[19] In the early sixteenth century Polydore Vergil considered that 'of Englishe men moe are grasiers and masters of cattayle than howsbande men or laborers in tilling of the fielde ….. allmoste everie where a man maye se clausures and parckes paled and enclosed', Ellis, *Vergil's English history*, p. 5; Mileson, *Parks*, pp. 45-72.

[20] Young, *Royal forests*, pp. 74-134; Grant, *Royal forests*; Campbell and Bartley, *Eve of the Black Death*, pp. 55-68, 150-7.

[21] Clark, 'Growth or stagnation?', p. 1.

[22] Broadberry and others, *British economic growth*, p. 50.

[23] Barnett, *Two tracts*, p. 35; Thirsk and Cooper, *Economic documents*, pp. 765-7. King excluded rotational grasses, although their acreage was small.

arable land than it would do four centuries later, more even than in 1801, but not as much as in 1871. At all these dates, however, broad continuities prevailed in the relative balance struck between arable and pastoral land uses and in the geographical distribution of arable cultivation, albeit with due allowance for certain well known regional discontinuities.

Net changes in the total arable acreage, 1290-1871

On the figures set out in *BEG*, a net addition of approximately 1.10 million acres was made to the country's arable area between 1290 and 1871 in contrast to the net reduction of over 4 million acres advocated by Clark. Over the intervening six centuries additions to the arable area came from reclamation of wetland, the under-drainage of heavy land, the reclamation of light land, plus disafforestation and the clearance of woodland. Offsetting these gains were losses from laying arable down to grass in response to changing relative prices, from encroachments by the expanding built up area, and from the incorporation of farmland into landscaped parks reserved for recreational use. *BEG* gives estimates for the scale of some of these land-use changes but not all and the assumption was made that in most instances they cancelled each other out. This exercise is refined here, paying particular attention to land-use changes associated with different soil types, yielding the results shown in Table 2.[24]

Table 2 about here

Rows B1 to B4 of Table 2 quantify the main net additions to the arable area between 1290 and 1871. The drainage of marshland has been well documented and Grigg uses a figure of 1.39 million acres drained in England from a paper by Marshall and others: in fact their estimate is higher at 1.98 million acres.[25] Measuring the areas of marshland from the soil map reproduced by Overton gives 2.3 million acres.[26] Not all of this was converted to arable when drained and in the 1930s some 55 per cent was under arable.[27] Thus arable gains from the drainage of marshland are estimated at 1.3 million acres (Table 2 Row B1). Additionally, there was considerable soil under-drainage from the 1840s. About 11.3 million acres of England are classed as heavy land and estimates of the area drained by the 1870s range from 4.5 to 10

[24] Overton, *Agricultural revolution*, pp. 58-59.

[25] Grigg, *English agriculture*, p.29; Marshall and others, 'Land drainage', p. 255.

[26] Overton, *Agricultural revolution*, p. 58.

[27] Marshall and others, 'Land drainage', p.259.

million acres.[28] The lower estimate is from Phillips, who considers that most of this newly drained land was already under arable cultivation, so that only 0.10 million acres were added to the arable by this method (Table 2, row B2).[29]

Reclamation of light land was a feature of agricultural development from the late seventeenth century onwards. Indeed, the classic Norfolk four-course rotation of the 'agricultural revolution' was instrumental in bringing the light lands of East Anglia, the chalk downs of southern England, the Lincoln Heaths and the Yorkshire Wolds under the plough.[30] This process has been described in many regional and local studies and it is likely that at least 1.0 million of the 4.0 million acres characterised as light land switched from pasture to arable (Table 2, row B3).[31]

Progressive substitution of coal for firewood from the sixteenth century also allowed much woodland to be converted to agricultural land uses. Overton puts the area of England that was wooded at around 10 per cent in 1350, which is probably a lower-bound estimate but is further complicated by the fact that land under forest law was not necessarily wooded, so that extensive post-medieval disafforestation mainly lifted restrictions on land use.[32] King put woodland at 7.7 per cent of the land area and by 1871 it had fallen to 4 per cent.[33] Sticking with the lower-bound medieval figure suggests that about 2 million acres of woodland, much of it on inferior soils, were lost, of which under half — 0.8 million acres — was sufficiently fertile to justify the substantial costs incurred in its conversion to arable cultivation Table 2, row B4).[34]

Compared with aggregate arable gains of approximately 3.2 million acres, net losses were smaller and amounted to around 2.1 million acres. There is no doubt that there was considerable conversion of arable to pasture between the middle ages and the late nineteenth

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[28] Phillips, *Underdraining*, p. 242; Robinson, 'Farm underdrainage'.

[29] Phillips, *Underdraining*, pp. 217-40; Grigg, *English agriculture*, pp. 32-34; Holderness, 'Prices, productivity and output', pp. 126-7.

[30] Overton, *Agricultural revolution*, pp. 91-2; Grigg, *English agriculture*, p. 34; Jones, 'Eighteenth-century changes'; Grigg, *Agricultural revolution*, pp. 69-71, 156-1; Harris, *Rural landscape*, pp. 100-2 .

[31] Overton, *Agricultural revolution*, p. 58

[32] Overton, *Agricultural revolution*, p. 90. Young, *Royal forests*; Grant, *Royal forests.* . Richard Unger, personal communication, estimates that 11.5 per cent of land would have been needed to satisfy demand for firewood in 1300.

[33] Thirsk and Cooper, *Economic documents*, p. 779; *Agricultural returns*. By the 1930s it was 5.6 per cent.

[34] Belcher, 'On the reclaiming of waste lands'.

century, particularly during the era of parliamentary enclosure, and arable ridge and furrow now fossilised under pasture bear witness to this.[35] In *BEG* it is shown how this conversion was mostly concentrated in a narrow range of counties lying along the boundary between the predominantly arable-farming counties of the southeast and the more pastoral counties of the north and west and mainly took place between 1380 and 1500 and again after 1650.[36] Clark, picking up on a conference paper by Williamson, reports that some 63 per cent of Northamptonshire was arable c.1300 and 45 per cent in 1871 (a loss of only 0.11 million acres) and wonders whether this may have been representative of England.[37] A further 0.3 million acres may similarly have been removed in Leicestershire, southeast Warwickshire and the clay vales of Buckinghamshire. Yet in other midland counties (Bedfordshire, Cambridgeshire and Huntingdonshire), Williamson and others point out that enclosures were seldom followed by large-scale conversion to grass.[38] Thus Northamptonshire is clearly not representative of all enclosed heavy land.[39] Given that other areas of the country saw the conversion of arable to pasture, total losses from this land-use switch have been estimated at 0.80 million acres (Table 2 row C1).

Apart from the substitution of one agricultural land use for another, there were permanent losses to the agricultural area from the expansion of the built-up area and intensification of transport networks. These losses may have been locally significant but nationally were quite modest. Between 1290 and 1850 the urban population of England increased by a little over 8 million.[40]At an urban population density of approximately 7 persons per acre, urban expansion would therefore have consumed around 1.1 million acres of land, although not all of this would have been arable.[41] Further losses arose from elaboration of the country's transport network. Taking the mileage of turnpike trusts as an indicator of investment in roads outside towns yields a figure of around 20,000 miles by their peak period of the

[35] For example, Mead, 'Ridge and furrow'; Harrison and others, 'Midland ridge and furrow'; Sutton, 'Ridge and furrow'; Hall, *Open fields.*

[36] Broadberry and others, *British economic growth*, pp. 57-60, 60-4.

[37] Clark, 'Growth or stagnation', p. 3; Williamson and others, *Champion*.

[38] Williamson and others, *Champion*, pp.183-8.

[39] Clark, 'Growth or stagnation?', p. 3.

[40] Estimated from Campbell, 'Benchmarking', p. 931; Lees, 'Urban networks', p. 70.

[41] Wood, 'Urbanization', p. 276.

1830s.[42] Even in the unlikely scenario where they had all been driven through prime farmland, this would still have resulted in a trivial loss of arable acres, given the width of the roads. The figures for canals are even smaller, with Duckham suggesting a peak mileage for inland waterways in the mid nineteenth century of around 1,400 miles for rivers and 2,600 miles for canals.[43] In contrast, the extent of Britain's railway network in 1870 was 13,562 miles.[44] Allowing a generous 2 acres per mile (implying a line width of 5.5 yards), and ignoring the fact that many lines passed through urban areas, would result in a loss of less than 28,000 acres, only some of which would have been arable. At most, therefore, around 20,000 acres of arable land may have been forfeited to roads, canals and railways. Overall, therefore, post-1290 arable losses to urbanisation and development are unlikely to have exceeded 1 million acres (Table 2, row C2).

Potentially greater losses occurred from the fashionable creation of landscaped parks. Prince uses early twentieth-century Ordnance Survey maps to assess the percentages of total land area devoted to parkland, showing a sharp decline from 17.5 per cent within a 1 to 15 mile radius of London, where gentlemen's seats had proliferated under metropolitan influence, to 8.5 per cent within a 15 to 30 mile radius and 4.0 per cent outside a 30 mile radius of the capital.[45] At a far greater remove from London, Goodchild reports that parkland accounted for 4 per cent of Nottinghamshire and 1.9 per cent of the West Riding of Yorkshire.[46] Extrapolating from these figures suggests that by 1871 private parks occupied less than 5 per cent of England's total land area, or around 1.6 million acres. It is clear, however, that the vast majority of this land was not previously in arable use. Indeed, Prince emphasises that parkland was especially concentrated on land of poor soil quality, ill-suited to agricultural use and for this reason often clustered in the vicinity of former royal forests and private chases.[47] Numbers of the greatest parks were of medieval origin and the *inquisitiones post mortem* (IPMs) indicate that parkland was already established as a distinctive land use by the beginning of the

[42] Albert, 'Turnpike trusts', p. 60.

[43] Duckham, 'Canals', p. 109.

[44] Mitchell, *British historical statistics*, p. 541.

[45] Prince, 'Parkland'; Stone and Fawtier Stone, *Open elite?*, pp. 253-4.

[46] Goodchild, 'Geography of parklands', p. 15, citing Fowkes, *Nottinghamshire parks*, and Coates, 'Development and distribution'.

[47] Prince, 'Parkland'.

fourteenth century, when probably over 3,000 parks were in existence.[48] Parkland was plainly a beneficiary of the process of disafforestation, probably expanding by between 0.5 and 0.75 million acres between 1290 and 1871. The net loss of arable land to landscaped parks is therefore likely to have been of the order of 0.30 million acres (Table 2, row C3).

Working back from an arable acreage of 13.83 million acres for 1871 in row A of Table 2, and taking account of both the net arable gains since 1290 in rows B1 to B4 and the net arable losses in rows C1 to C3, yields the figure of 12.73 million arable acres for 1290 in row D. Since the net gains to the arable area from disafforestation and reclamation of the heaviest and lightest soils are more likely to have been underestimated than the net losses, this figure should be regarded as an upper-bound estimate and highlights how historically unfounded is the arable acreage of between 18.0 and 19.4 million acres in 1290, as postulated by Clark.[49] For him to be correct, he would need to be able to explain not only the loss of over 4 million acres by 1871 but also the more astonishing losses of nearly 7 million acres by 1801 (at a time of maximum national need during the Napoleonic Wars, when the arable area was 11.35 million acres) and over 8 million acres by the 1690s (the last an amount of land equivalent in area to the six northernmost counties of England). Curiously, the withdrawal of such a vast amount of land from arable cultivation has wholly escaped the attention of historians.[50] The onus is therefore on Clark to produce convincing empirical evidence that these millions of acres of 'lost' arable had ever existed and show where exactly they were located; generalising from the occasional anecdotal example will not suffice.

Geographical continuities in arable land use 1086 to 1871

In England the balance struck between arable and pastoral land uses always exhibited much geographical variation. This was as pronounced in 1086 as it would be in 1871 and reflected the immutable nature of the environmental factors shaping land use. Self-evidently, too, for as long as working animals and humans provided the bulk of all animate power employed in agriculture, the distributions of rural population and arable land use tended to march together.

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[48] Campbell and Bartley, *Eve of the Black* Death, pp. 150-6; Mileson, *Parks*, pp. 3, 48-59, 109.

[49] It is also approximately 10 per cent higher than the estimate for 1300 of 10.5 million acres in Campbell, *Seigniorial agriculture*, p. 390, again within the bounds of measurement error. Clark, 'Growth or stagnation?', pp. 3, 9.

[50] Clark, 'Growth or stagnation?', p. 2, citing Allen, 'Reconnaissance map', reports the conversion of c.5,500 acres of alluvial land in the Vale of Berkeley, but Gloucestershire is a special case. In 1086 it was exceptional in supporting the highest of all densities of plough teams and is one of a group of midland counties whose arable area is known to have contracted after 1290.

The relative and absolute amounts of arable land in 1086 can be derived using the same method as for 1290 but with the critical difference that recorded numbers of Domesday plough teams provide a crosscheck on the results thereby obtained (Table 3). The starting point for these new estimates is the county distribution of population as reported in *BEG*.[51] This is then combined with the lowland acreage of each county, excluding land above 200 metres, since this is taken to be the normal altitudinal limit to grain production. Allocating 3.17 arable acres per head for a total population of 1.71 million, yields a total of 5.41 million arable acres, which is just sufficient to feed a population of that size with grain yields at medieval levels.[52] The regional distribution of lowland arable acres per head is then allowed to vary on a sliding scale from 1.50 in the most densely populated county of Middlesex to 4.25 in the least populous counties, on the assumption that the lower the population density the more extensive were the cultivation methods employed (with more fallow and lower yields). Table 3 summarises the results, expressed in as a percentage of the total lowland acreage, for eight regional county groupings. As will be seen from the final column of Table 3, they are in broad agreement with the recorded distribution of plough teams per 1,000 lowland acres (correlation coefficient = +0.96).[53]

Table 3 about here

In 1086 plough-team densities were highest in the southwest and west midlands and some 5-15 per cent lower in the eastern counties, whose significantly higher population densities nonetheless imply that at least as much land was under arable land use. Nor were the populous southeastern counties far behind. In fact, across a broad swathe of eastern, southeastern and central England tillage cultivation accounted for a quarter of all lowland land-use by 1086 and, wherever this was the case, plough-team densities were correspondingly high. Arable land use appears to have been less developed in the southwest, where densities of population and plough teams were both lower, and was least developed throughout the north of England, where marked scarcities of tenants and teams bear witness to the scorched earth policy so recently meted out by William I and his armies.[54] Collectively, England's eight

[51] Broadberry and others, *British economic growth*, p. 20.

[52] Campbell, *English seigniorial agriculture*, pp. 387-8; Broadberry and others, *British economic growth*, pp. 90-7.

[53] Darby, *Domesday England*, pp. 121-35.

[54] Darby, *Domesday England*, pp. 248-52.

northernmost counties contained a quarter of the country's lowland but, after allowance for the un-surveyed counties of Cumberland, Westmorland, Northumberland and Durham, only approximately 8 per cent of its plough teams and 9 per cent of its arable land. In 1086 political factors had therefore exaggerated the natural contrast between a closely settled tillage-based south and east and a less populous pastoral-based north and southwest. Nevertheless, as will be plain from Table 4, even after these losses had been made good, this divide has remained one of the most indelible features of England's agricultural geography.[55]

Table 4 about here

Eight centuries later the *Agricultural returns* capture agricultural land use at the point when price incentives to maximise domestic food production remained strong, disafforestation and enclosure had largely run their separate courses, and farmers possessed the technology to cultivate some of the country's heaviest and most intractable soils, so that arable thus accounted for an impressive 58.9 per cent of the agricultural area and 42.8 per cent of the country's total area. Table 4 demonstrates that in 1871, as in 1086, the most arable region was the eastern counties, where 63.0 per cent of the total acreage was devoted to arable, rising to a national maximum of 75.6 per cent in Cambridgeshire where extensive drainage had allowed much former peat fenland to be brought into productive use.[56] At the opposite extreme, just 24.5 per cent of the total acreage was devoted to arable in the northwest and 34.1 per cent in the northeast. Here, for all the progress made incorporating fodder crops and sown grasses into arable rotations, permanent grassland remained a prominent component of land use. This unevenness in the relative distributions of arable and grassland echoed the situation in 1086 and did so for much the same geographical reasons, now powerfully reinforced by commercial specialisation according to comparative advantage. Arable had made some notable net gains, most conspicuously in the north, but, as already noted, had lost ground to pastoral land uses in the midlands.

In certain respects the 1801 crop returns, compiled at a time of acute pressure upon national food supplies but prior to the boost to arable cultivation from technological advances such as under-drainage and the final surge of parliamentary enclosures of commons and waste,

[55] Roberts and Wrathmell, *Atlas.*

[56] County estimates of arable are mapped for 1801, the 1830s, and 1871 in Overton, 'Agriculture', p. 35. The Cambridgeshire data are shown in Broadberry and others, *British economic growth*, p. 51

provide a more appropriate basis for comparison with the corresponding situation in 1290.[57] They are better at revealing the relative rather than absolute amount of land under arable cultivation and confirm that the most arable counties were located in East Anglia and the southeast and the most pastoral in the northwest and the southwest. The continuity with the situation seven centuries earlier is again striking, although the withdrawal of land from arable cultivation in parts of the midlands is already evident (Table 4). On the assumption of a national arable area of 11.35 million acres, the proportion of land under arable rotations in 1801 ranged from a minimum of 13.2 per cent in Lancashire to a maximum of 65.1 per cent in Suffolk.[58]

At all three dates, 1086, 1801 and 1871, the proportion of land under arable rotations varied a great deal geographically (Table 4). The lowest shares were consistently in the hilly, cool and rainy north, northwest and southwest where, by the nineteenth century, arable land typically comprised between a fifth and a quarter of the total. Proportions two to three times as great prevailed in the country's premier grain-producing regions, namely East Anglia and the southeast, but only exceptionally exceeded two-thirds of the land area of individual counties and rarely if ever exceeded three-quarters in even the most favoured individual localities.[59] Strong regional contrasts in land use and the relative size of the arable sector were thus an abiding feature of English agriculture, reflecting the real environmental, institutional and economic constraints that shaped production[60]. Reliance upon organic methods of production and animate sources of power meant that grassland, whether several or common, enclosed or unenclosed, improved or unimproved, was always a significant land use in its own right and was undoubtedly at its most important prior to the incorporation of fodder crops into arable rotations from the seventeenth century. Hence Gregory King's view that in the 1690s there was just under an acre of grassland for each acre of arable, although that ratio undoubtedly varied

[57] Overton, *Agricultural revolution*, pp. 93, 150-1.

[58] Broadberry and others, *British economic growth*, p. 74.

[59] Clark, 'Growth or stagnation?', p.4, citing Hallam, *Settlement and society*, 195-6, draws attention to estimated late thirteenth-century arable land-use shares of 66-76 per cent in the silt fens and fen edge of south Lincolnshire but these are entirely consistent with the exceptionally high population densities then prevailing in this privileged area of active colonisation and rich alluvial soils (Campbell and Barry, 'Population geography', p. 65). Elsewhere in the county population densities were significantly lower, as was consistent with an arable land-use share estimated by *BEG* for Lincolnshire as a whole of 57.5 per cent. For an analysis of the range and distribution of land-use configurations reported by the *inquisitiones post mortem* see Campbell and Bartley, *Eve of the Black Death*, pp. 197-208 and map 11.5.

[60] Overton, 'Agriculture', p.35.

a good deal from region to region.[61] The situation can have been little different in 1290 when the country stocked an estimated 0.4 million horses, 2.24 million cattle (including working oxen), 15.7 million sheep and almost 1 million swine, with all but the pigs and the more expensive cart and riding horses dependent for the bulk of their sustenance upon grass in one form or another, of which, with these numbers, there needed to have been at least 10 million acres.[62]

III Some logical puzzles raised by Clark

Clark bolsters his disregard for the geographical and historical realities that underpin the *BEG* estimates of the arable area with a number of logical assertions intended to justify a substantially higher estimate. None, however, withstands serious scrutiny.

Harvest labour

First, Clark argues that the level of arable output in *BEG* before 1750 would have been insufficient to keep the agricultural labour force fully employed at harvest time, which he takes as an established fact because of the existence of a substantial harvest wage premium.[63] This disregards the large elements of customary behaviour in the medieval labour market, where money wages changed remarkably little over periods of half a century or longer, a fact that can be overlooked when attention is focused primarily on real wages, which fluctuated through changes in prices.[64] It also ignores the simple point that, with double the available daylight hours, a day's work during the harvest period was substantially longer than during the winter and involved entirely different tasks that had to be carried out within strict time constraints. Clark also plays down the strenuous nature of those harvesting tasks, even though in arable parishes marriages were often postponed until after the harvest was over (in contrast to the spring marriage peak in pastoral parishes, following hay-making, calving and lambing).[65] These factors of customary wage rates, longer hours, different tasks performed under time pressure, and the different balance between arable and pastoral activities in different regions make the

[61] Barnett, *Two tracts*, p. 35.

[62] Broadberry and others, *British economic growth*, pp. 106, 111, 283.

[63] Clark, 'Growth or stagnation?', pp. 6-10.

[64] Phelps Brown and Hopkins, 'Building wages'; Phelps Brown and Hopkins, 'Prices of consumables'; Munro, 'Nominal wage stickiness'.

[65] Clark, 'Growth or stagnation?', p. 7; Kussmaul, *General view*

relative constancy of the harvest premium over the winter wage rate easy to understand, without the need to invoke the permanent persistence of conditions of full employment at harvest time.[66]

Table 5 about here

More seriously, Clark's calculation of the number of harvest days available per man in his Table 3 is flawed.[67] For the level of output taken from *BEG*, he states that '(f)or the years 1770-1861 the labour requirement per man for the harvest tasks averaged 29 days', so this represented full employment from the eighteenth century onwards, but significant under-employment before then.[68] This result, which is shown in the first column of Table 5, depends crucially on the allocation of all male workers in agriculture to arable tasks, irrespective of the fact that the pastoral sector accounted for between 42.2 and 63.8 per cent of the value of agricultural output. In the third column of Table 5, Clark's estimates of total harvest days per man have therefore been reworked using the same assumptions for the total harvest days, but allocating the male farm labour force in agriculture between the arable and pastoral sectors in proportion to their shares of current price output (as shown in the second column). This results in around 30 days of harvest labour per man in the low demand years, and considerably more in the other years. In short, using the same numerator as Clark, but a more realistic denominator completely removes the alleged problem of insufficient demand to keep the available male labour force fully employed during the medieval period.

Wages and the value of output

The lack of the consistency between daily real wages and GDP per capita is dealt with at some length at the aggregate level in *BEG*, where it is shown that the discrepancy between the trends in the two series can be explained primarily by variation in the days worked per year, with subsidiary roles for changes in the relative price of food and labour's share of GDP.[69] This issue can also be addressed at the sectoral level, with Clark arguing that in agriculture the annual earnings per worker would have exceeded *BEG*'s estimated output per worker during the late-

[66] See Whittle, 'Food economy', pp. 42-5, reconstructs the selective employment of harvest labour on one Norfolk manor.

[67] Clark, 'Growth or stagnation?', p. 10.

[68] Clark, 'Growth or stagnation?', p. 9.

[69] Broadberry and others, *British economic growth*, pp. 247-78.

medieval period.[70] In fact, as set out in Table 6, it is straightforward to show that this was not the case.

Table 6 about here

The first step in estimating labour income in English agriculture is to establish the size of the agricultural labour force. This is set out in part A of Table 6, starting from the estimated size of the English population and share of the agricultural share of the labour force set out in *BEG*.[71] Although this can reasonably be used as an index of employment in agriculture, it needs to be adjusted to take account of annual days worked per person before it can be used as an index of total days worked in agriculture. Days worked per person are also taken from *BEG*, based on the work of Allen and Weisdorf.[72] The next step, in part B of Table 6, is to combine the index of total days worked with an index of the daily wage rate to arrive at an index of wage payments. The daily wage rate is taken from Clark, so that no difference can arise on that score.[73] Multiplying the index of total days worked from part A with the daily wage rate index yields an index of wage payments. Part B also provides data on the nominal value of agricultural output from *BEG*.[74] Finally, Part C of Table 6 derives an index of the wage share of output under the alternative assumptions of either an industrious revolution or a fixed 300-day working year. The results are expressed as the percentage of output accounted for by wage payments, benchmarking the index on Clark's figure of circa 40 per cent in 1850.[75] This is somewhat higher than Allen's figure of 34.6 per cent but, to ensure comparability, Clark's higher figure is again accepted.[76] Note that in the absence of an industrious revolution, labour's share of output would indeed have been much higher in the late-medieval period, although only in the 1450s would it have consumed more than the whole of output, and by a much smaller proportion than suggested by Clark's Figure 5. Clark's suggestion that the agricultural output series in *BEG* necessarily implies a wage bill that is greater than the value of output is thus

[70] Clark, 'Growth or stagnation?', pp. 11-12. Compare Clark's Figure 5, p. 11, with Broadberry and others, *British economic growth*, p. 258.

[71] Broadberry and others, *British economic growth*, pp. 20, 227-244, 344.

[72] Broadberry and others, *British economic growth*, p. 264; Allen and Weisdorf, 'Was there an industrious revolution?'. Using the days worked series from Humphries and Weisdorf, 'Unreal wages?', discussed in the next section, would only strengthen our argument.

[73] Clark, 'Long march', pp. 99-100.

[74] Broadberry and others, *British economic growth*.

[75] Clark, 'Growth or stagnation?', Figure 5.

[76] Allen, 'English and Welsh agriculture'.

rejected. The problem arises only because of Clark's refusal to countenance an increase in days worked per year. This leads to Clark's next puzzle, the pre-industrial work year.

The pre-industrial work year

Clark claims that since the harvest wage premium remained constant between 1270 and 1870, then the length of the work year must also have remained constant.[77] First, he argues that the harvest wage premium is an indication that all agricultural workers must have been fully employed during the harvest season, although, as noted above, the existence of a harvest premium was not necessarily dependent on full employment. Second, he claims that the ratio of labour demand outside the harvest season to labour demand during harvest did not change substantially, so there must have been full employment outside the harvest season during the medieval period as well as during the modern period. Yet this is inconsistent with his suggestion of a ratio of 3 to 3.5 days of non-harvest labour per day of harvest labour which, when combined with his estimated average of 29 days per man during the harvest season for the years 1770-1861, yields a total of just 116 to 131 days, a lot less than his assumed 250 to 300 days worked per year.[78]

In fact, there is now a growing body of evidence to support the idea of an increase in the length of the working year, or an 'industrious revolution' commencing sometime in the fifteenth century. As noted in *BEG*, Blanchard finds an increase in the number of days worked from 165 in 1433 to 259-260 in 1578-1598, while Voth finds an increase from 258 days in 1760 to 333 days in 1830.[79] Interestingly, Clark and van der Werf are in broad agreement with Blanchard and Voth for the periods when their data overlap. Their estimate of the average number of days worked per year during the period 1560-1599 is 257, which is close to Blanchard's estimates for the late sixteenth century. Similarly, their estimate of 293-311 days for 1867-1870, is close to Voth's figures for the nineteenth century.[80] The main differences are two-fold. First, Blanchard finds a substantially shorter working year in 1433 at just 165 days, implying an earlier start to the industrious revolution.[81] Second, whereas Voth finds a working

[77] Clark, 'Growth or stagnation?', p.13.

[78] Clark, 'Growth or stagnation?', pp. 9, 13

[79] Broadberry and others, British economic growth, p.264; Blanchard, 'Labour productivity', p.24; Voth, 'Longest years', p.1078.

[80] Clark and van der Werf, 'Work in progress?', p. 838.

[81] Blanchard, 'Labour productivity', p. 24.

year of 258 days in 1760, which is almost identical to Blanchard's figure of 259 days in 1598, Clark and van der Werf find that the working year had already risen to 312 days by 1685.[82]

Fortunately, a more continuous picture of the length of the working year over the whole period from 1270 to 1870 has now been provided by Humphries and Weisdorf.[83] They have collected data on annual wage contracts rather than daily wage rates, which more accurately reflect annual earnings.[84] By comparing annual with daily wages, they infer a working year of around 200 days at the opening of the fourteenth century which halved to around 100 days immediately following the Black Death but thereafter gradually lengthened to reach 250 days by the close of the seventeenth century and eventually 300 days by the 1750s. This broadly endorses Hatcher's observation that deflating the daily male wage-rate series of Phelps Brown and Hopkins with their price series creates an 'unreal' real wage series.[85] Tellingly, it deviates significantly, from Clark's alternative calculations of annual earnings based upon daily wage rates and a constant work year of either 250 or 300 days but tallies with Allen and Weisdorf's calculation of the number of days' earnings needed to purchase some version of the bare-bones basket of consumption required to meet the subsistence needs of a family of two adults and two to three children.[86] And it tracks a similar path to the output-based GDP per capita series presented in *BEG*.

Equalisation of returns

Clark resurrects a now redundant theoretical view to infer that there had to be more arable land than suggested in *BEG* in order to equalise *average* output per acre across arable and pasture.[87] Whether this was attainable is another matter. As he acknowledges, there were many institutional restrictions on land use, as a protection against farmers maximising short-term profits at the expense of long-term yields.[88] Further, land rents were fixed for long periods, only changing when land was sold or a new contract was drawn up, so that rental returns varied with

[82] Voth, 'Longest years', p. 1078; Blanchard, 'Labour productivity', p. 24; Clark and van der Werf, 'Work in progress?', p. 838.

[83] Humphries and Weisdorf, 'Unreal wages?', pp. 25-7.

[84] Humphries and Weisdorf, 'Unreal wages?'.

[85] Hatcher, 'Unreal wages'; Phelps Brown and Hopkins, 'Building wages'; Phelps Brown and Hopkins, 'Prices of consumables'.

[86] Allen and Weisdorf, 'Industrious Revolution?'.

[87] Clark, 'Growth or stagnation?', p. 3.

[88] Clark, 'Growth or stagnation?', footnote 10; Clark, 'Economics of exhaustion', p. 67.

the type and length of tenure.[89] The existence of large amounts of common land, with communal restrictions on use, and on which no rent was paid, adds a further complication to the issue.[90] Nevertheless, even if there were no common land, no restrictions on land use, and rents were changed every year, in theory equalisation of returns should apply only at the *margin*, so there can be no presumption that average nominal output per acre should be equalised between arable and pasture.[91]

More surprisingly, Clark's claim lacks a secure empirical basis, since the functional division of farmland between arable and pasture is blurred, which affects the denominator in the calculation of output per acre on the two types of land. At a general level, in a mixed-farming system, if farmers graze their working animals on pieces of pasture but use them for ploughing their arable land, should that pasture be assigned to the arable or non-arable sector?[92] The same issue applies to fallow arable used as temporary pasturage for livestock. More specifically, and leaving aside the mixed-farming issue, Clark's division of non-arable land between pasture and other uses such as woodland and waste is in any case unclear. In his Figure 7, for example, he assumes that the total farming area in 1300 was 28.2 million acres, so that with 12.72 million acres of arable, there would have been 15.68 million acres left over for non-arable uses, or 54.9 per cent of farmland. Despite Figure 7 containing the legend 'pasture and wood', Clark ignores woodland and attributes all of this to the livestock sector, which accounted for 48.8 per cent of the value of agricultural output in 1300, concluding that pastoral output per acre was only 78.3 per cent of arable output per acre. Nevertheless, as noted earlier, *BEG* estimated England's potential agricultural area at 24 million acres, which would reduce the amount of pasture in 1300 to 11.28 million acres, or 47.0 per cent of total farmland.[93] This is slightly less than the 48.8 per cent of agricultural output accounted for by the livestock sector, thus suggesting that output per acre in pasture was 107.5 per cent of the output per acre in arable, i.e. the pastoral sector was slightly more productive than the arable sector, rather than substantially less productive, as Clark tries to suggest in his Figure 7. It must be emphasised,

[89] Clark, 'Agriculture and the industrial revolution', p. 245; Kanzaka, 'Villein rents'.

[90] Campbell and Bartley, *Eve of the Black Death*, pp. 55-68.

[91] Although Adam Smith, *Wealth of Nations*, p. 168 clearly thought in terms of incentives to convert production between arable and pasture in response to profit opportunities, he was writing before the marginal revolution, and therefore, understandably, did not distinguish between marginal and average returns. He put much emphasis on situations where returns differed, pp.165-8.

[92] This issue was raised by Smith, *Wealth of Nations*, p. 167.

[93] Broadberry and others, *British economic growth*, p. 50.

however, that no particular significance should be attached to this result, since, as has already been noted, it is *marginal* output per acre that mattered and there is no reason to expect *average* output per acre in arable and pasture to be equalised. It is included here simply to show that Clark's claim of inconsistency lacks a strong empirical as well as theoretical basis.

IV CONCLUSIONS

Clark's vision of late-medieval England is fraught with contradictions. First, according to him, the country was surfeited with arable land — more than at any subsequent date — and yet suffered the worst food crises and lowest agricultural real wage rates in the country's recorded history.[94] Second, much of the land that he envisages having been brought into cultivation could hardly have been fit for the purpose, and would necessarily have been at the expense of the vital pastoral sector, yet notwithstanding the ecological risks thereby incurred he sees agricultural output as remaining high and buoyant. Third, so vast an arable area would have meant that in many regions the amount of arable would have been far in excess of local needs, yet net grain exports were negligible and it was pastoral products — wool and hides — that constituted the country's principal exports until the late fifteenth century. Fourth, following the Black Death, when on Clark's own estimates the population more than halved, he believes that agricultural output scarcely shrank at all. Fifth, according to Clark, both before and after the Black Death farm labourers worked a full working year of 300 days irrespective of whether they needed to or sufficient employment was available. Sixth, even with a peak medieval population of 5.98 million in the 1310s, Clark sees conditions of full employment invariably existing at harvest time, so that in that respect, conditions of Malthusian 'over population' never prevailed.[95] Yet according to him this was a Malthusian economy with the result that GDP per head was at a maximum in the mid fifteenth century when the population was at a minimum and the European economy was in the grip of a deepening commercial recession.[96] Seventh, at that time, on his reckoning, England was already at least as rich as it would be in the early nineteenth century, when the country had a per capita income of around $2,000 in 1990 international prices, which is about five times bare-bones subsistence and would have

[94] Clark, 'Long march', pp. 109-10; Campbell, 'Four famines'.

[95] Clark, 'Long march', p. 120.

[96] Hatcher, 'Great slump'; Nightingale, 'European depression'; Campbell, *Great Transition*, pp. 355-73. For a contrasting view of this episode see Dyer, 'Golden age rediscovered'.

been enough to make it the richest country in the world.[97] Improbably, this would have put mid-fifteenth-century England ahead of the far more developed and urbanised economy of central and northern Italy and the economically most advanced regions of eastern China.[98] In Clark's world, once the population began to recover from the 1500s the country did not return to this apogee of per capita prosperity until the very end of the nineteenth century, long after it had been launched on the path of modern economic growth.

In place of Clark's pessimistic picture of Malthusian fluctuations without trend, *BEG* provides a historically credible alternative of England developing from an underdeveloped backwater of Europe in the late thirteenth century to the hub of the global economy by the late nineteenth century and changing profoundly in structure in the process. In the preface to the book we wrote:

> 'Like Deane and Cole before us, we both hope and expect that the data assembled, methods employed, assumptions made and estimates derived will prompt debate and provoke and stimulate others to undertake more work and in due course come up with a more robust set of results'.[99]

Promising signs that this is happening are beginning to emerge. Humphries and Weisdorf and Stephenson challenge the narrow interpretation of the daily real wage series first introduced by Phelps Brown and Hopkins.[100] Allen suggests further refinements to the social tables.[101] Dyer, Langdon, Slavin and La Poutré explore medieval agricultural output outside the demesne sector.[102] Kelly and Ó Gráda, Meredith and Oxley, and Harris and others debate levels of food consumption per head.[103] Shaw-Taylor and Wrigley, Keibek, and Wallis and others are working on the shifting occupational structure of England.[104] Palma charts the contribution of the money

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[97] Broadberry and others, *British economic growth*, pp. 375-6.

[98] Malanima, 'Long decline', pp. 185-8, 204-8; Campbell, 'National incomes', pp. 169-72; Allen, 'Agricultural productivity'; Broadberry and others, 'China'.

[99] Broadberry and others, *British economic growth*, p. xxii.

[100] Humphries and Weisdorf, 'Wages of women'; Humphries and Weisdorf, 'Unreal wages?'; Stephenson, 'Real wages?'; Phelps Brown and Hopkins, 'Building wages'; Phelps Brown and Hopkins, 'Prices of consumables'.

[101] Allen, 'Revising'.

[102] Dyer, 'Peasant farming'; Langdon, 'Bare ruined farms?'; Slavin, 'Peasant livestock'; La Poutré, 'Fertilization by manure'.

[103] Kelly and Ó Gráda, '*Numerare est errare*'; Meredith and Oxley, 'Food and fodder'; Harris and others, 'How many calories?'.

[104] Shaw-Taylor and Wrigley, 'Occupational structure'; Keibek, 'Regional and national'; Wallis and others, 'Puncturing'.

supply to the growth process.[105] Crafts and Mills, Nuvolari and Ricci, and Groth and Persson are all assessing the growth patterns suggested by the new series and probing the underlying assumptions.[106] None of this work is consistent with the old Malthusian view, which Clark, clinging to a narrow interpretation of the daily real wage series, is seeking to reinstate. The tide, however, is against him: his estimates are contradicted by just about every other recent indicator of long-run development, all of which show a steady upward trend.[107]

It is surely time now to abandon the Malthusian interpretation of the British economy before the nineteenth century, recognise that daily real wage rates are less diagnostic of annual earnings and general economic trends than once thought, and concentrate on refining the story of pre-industrial growth and development and extending it to other well-documented economies.[108] Contrary to the Malthus delusion of Clark, the industrial revolution was not the beginning of development, but rather the culmination of a long, slow and uneven process reaching back at least as far as the late medieval period and by no means confined to Britain. In England, agriculture's contribution to this process was to raise output more-or-less in step with domestic demand and, through improvements in labour productivity, release labour to other more dynamic employment sectors. There was little about this that was dramatic but the progress that resulted was undoubtedly real.

[105] Palma, 'Money supply'

[106] Crafts and Mills, 'Six centuries'; Nuvolari and Ricci, 'Economic growth'; Groth and Persson, 'Growth or stagnation'.

[107] Broadberry and others, *British economic growth*, pp. 274-5.

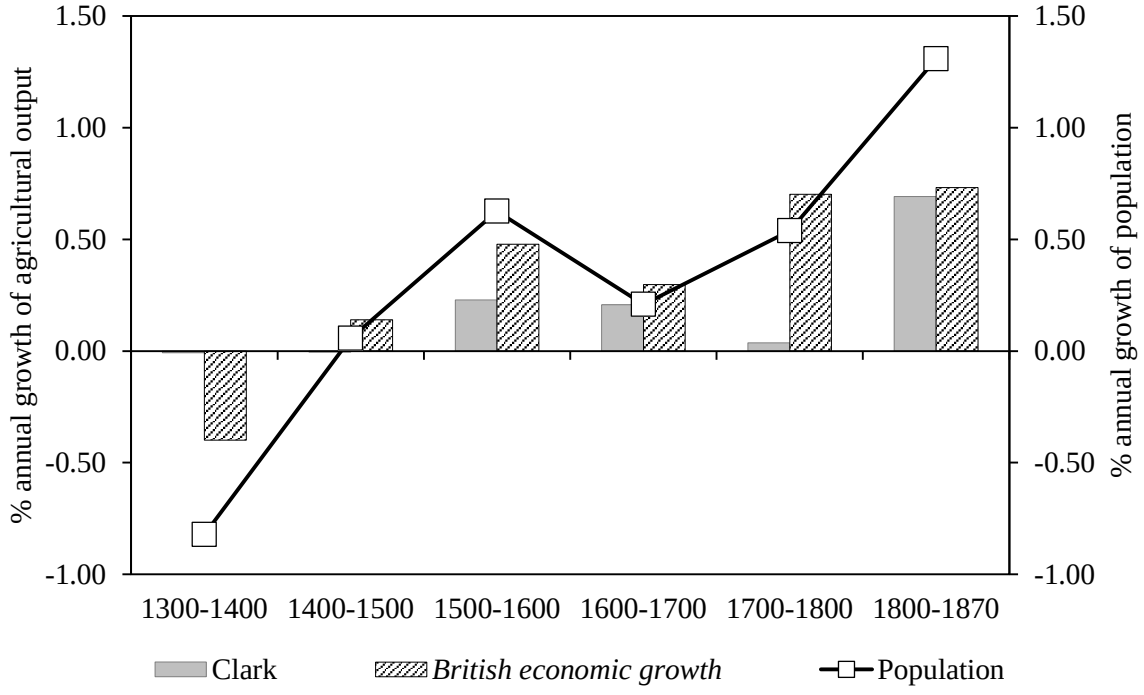
[108] Bolt and van Zanden, 'Maddison Project'; Pfister, 'Real wage divergence'.

TABLE 1: Annual growth rates of English agricultural output and population according to Clark and *British economic growth*

Years	Clark: % annual growth rate		*BEG*: % annual growth rate	
	agricultural output	population	agricultural output	population
1300-1400	-0.01	-0.60	-0.40	-0.82
1400-1500	-0.01	-0.04	0.14	0.06
1500-1600	0.23	0.43	0.48	0.63
1600-1700	0.21	0.17	0.30	0.21
1700-1800	0.04	0.54	0.70	0.54
1800-1870	0.69	1.31	0.73	1.31

Sources: Clark, 'Macroeconomic aggregates'; Clark, 'Growth or stagnation?'; Broadberry and others, *British economic growth,* pp. 125, 228-44.

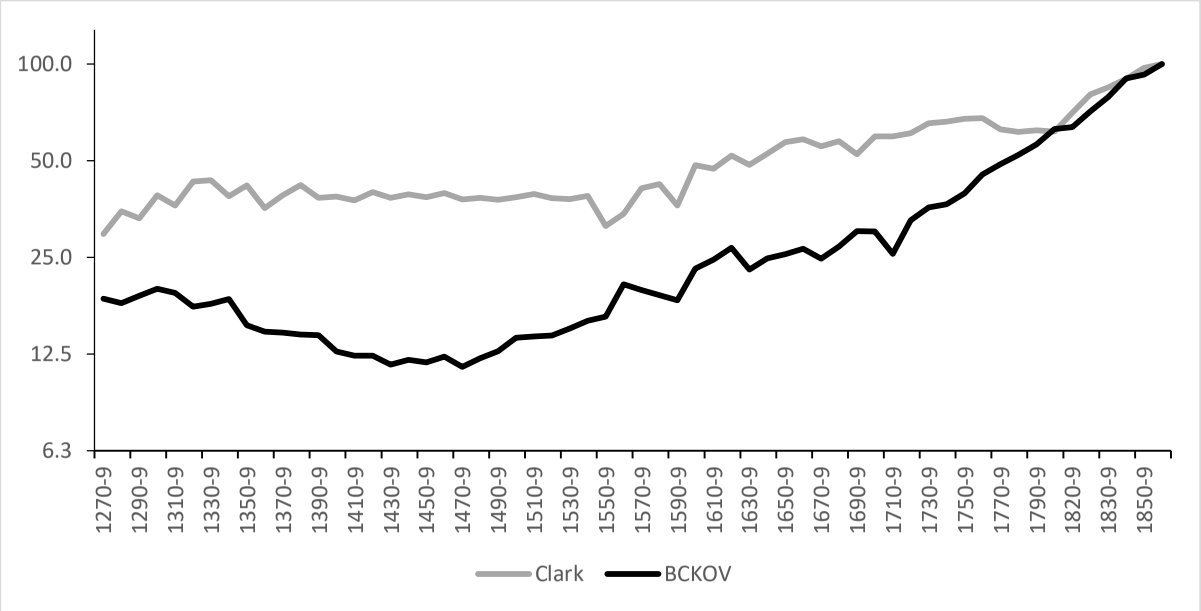
FIGURE 1: Annual growth rates of English agricultural output according to Clark and *BEG* and of population according to *BEG*



Source: Table 1.

FIGURE 2: English agricultural output, 1270s-1860s

A. 1860s = 100



B. 1700s=100

Sources: Clark, 'Growth or stagnation?'; Broadberry and others, *British economic growth*.

TABLE 2: Net changes in the arable acreage between 1290 and 1871

		Gains m. acres	Losses m. acres	Net total m. acres
A.	Arable acreage in 1871			13.83
B.	Arable net gains since 1290			
B1.	Net gains from drainage	+1.30		
B2.	Net gains from underdrainage	+0.10		
B3	Net gains from lightland reclamation	+1.00		
B4.	Net gains from woodland conversion	+0.80		
C.	Arable net losses since 1290:			
C1.	Net losses from conversion to pasture		-0.80	
C2.	Net losses from urbanisation & development		-1.00	
C3.	Net losses from conversion to parkland		-0.30	
D.	Arable acreage in 1290			12.73

Sources and notes: derived from Broadberry and others, *British economic growth*, pp. 54-65, with additional calculations as described in the text.

TABLE 3: Population, plough teams and the estimated arable area by region in 1086

Region	Total area ,000 acres	Lowland as % total	Population per 1,000 lowland acres	Assumed arable acres per head	Arable land as % of lowland area	Plough teams per 1,000 lowland acres
1. Eastern Counties	4,707	100.0	95	2.70	25.7	3.57
2. NE midlands	2,464	89.7	62	3.33	20.7	3.40
3. Southeast	6,733	98.9	77	3.20	24.6	3.62
4. SW midlands	3,353	89.8	80	3.09	24.7	4.21
5. West midlands	2,450	88.7	57	3.49	19.8	3.83
6. Northeast	5,814	68.4	16	4.25	6.9	0.96
7. Southwest	2,527	81.5	62	3.37	20.7	3.38
8. Northwest	4,051	74.5	18	4.25	7.5	0.95
England	32,100	86.6	61	3.17	19.5	2.99

Sources and notes: Total acreage taken from Broadberry and others, *British economic growth*, pp. 51-2. The lowland acreage excludes land above 200 metres, at which altitude cultivation of crops becomes difficult (we are grateful to Lorraine Barry for providing this information). Population taken from Broadberry and others, *British economic growth*, p. 25, based on the Domesday Survey. Assumed arable acres per head are linearly related to density per 1,000 lowland acres as described in the text. Arable acreage derived as the product of population and arable acres per head and expressed as a percentage of total lowland acreage. Plough teams taken from Darby, *Domesday England*, p. 336, adjusted to allow for the excluded northern counties (*in Italics*).

1. Eastern counties: Cambridgeshire, Huntingdonshire, Lincolnshire, Norfolk, Suffolk.
2. Northeast Midlands: Derbyshire, Leicestershire, Northamptonshire, Nottinghamshire, Rutland.
3. Southeast: Bedfordshire, Berkshire, Buckinghamshire, Essex, Hampshire, Hertfordshire, Kent, Middlesex, Oxfordshire, Surrey, Sussex.
4. Southwest Midlands: Dorset, Gloucestershire, Somerset, Wiltshire.
5. West Midlands: Herefordshire, Shropshire, Warwickshire, Worcestershire.
6. Northeast: Durham, Northumberland, Yorkshire.
7. Southwest: Cornwall, Devon.
8. Northwest: Cheshire, Cumberland, Lancashire, Staffordshire, Westmorland.

TABLE 4: Arable land use as a percentage of total acreage, 1086-1871

Region		(A) % of total area:				(B) Indexed % of total area:			
		1086	1290	1801	1871	1086	1290	1801	1871
1	Eastern counties	*25.4*	*58.8*	*49.7*	*63.0*	100	100	100	100
2	NE midlands	*18.6*	*49.0*	*29.7*	*39.2*	73	83	60	62
3	Southeast	*24.3*	*48.4*	*45.3*	*51.2*	96	82	91	81
4	SW midlands	*22.1*	*44.9*	*32.2*	*39.0*	87	76	65	62
5	West midlands	*17.4*	*40.2*	*35.7*	*41.9*	69	68	72	67
6	Northeast	*4.6*	*27.6*	*28.7*	*34.1*	18	47	58	54
7	Southwest	*16.7*	*25.0*	*21.6*	*40.6*	66	43	43	64
8	Northwest	*5.5*	*17.4*	*20.5*	*24.5*	22	30	41	39
	England	*16.7*	*39.4*	*34.6*	*42.8*	66	67	70	68

Sources and notes: 1086 (based on the Domesday Survey): see text and Table 3; 1290 (based on the lay subsidies for 1290, 1327 and 1332): Broadberry and others, *British economic growth*, p. 70; 1801 (based on the 1801 crop returns): derived from Turner, 'Arable', p. 294, with the assumption of a total arable area of 11.35 million acres; 1871 (based on the *Agricultural Returns for Great Britain*): Broadberry and others, *British economic growth*, pp. 51-2, 70. The counties making up each region are listed in the notes to Table 3.

TABLE 5: Harvest labour demands per man

Years	Harvest days per male worker in arable and pastoral agriculture	Arable share of output at current prices	Harvest days per male worker in arable agriculture
1270	19.4	0.575	33.7
1300	19.7	0.562	35.0
1380	22.0	0.534	41.3
1420	20.4	0.442	46.2
1450	20.9	0.357	58.6
1500	18.3	0.360	50.8
1600	16.9	0.578	29.3
1650	17.9	0.514	34.8
1700	22.2	0.570	39.0
1750	29.4	0.525	56.0
1770	28.4	0.551	51.6
1800	31.3	0.521	60.0
1830	27.7	0.424	65.4
1851	26.5	0.415	63.8
1861	26.1	0.362	72.0

Sources and notes: Harvest days per male worker in arable and pastoral agriculture: Clark, 'Growth or stagnation?', p.8. Our estimates differ slightly from those of Clark for some years because Clark used data from Broadberry et al., *British economic growth*, which were provided only for a limited number of years. These have been recalculated using the underlying data that were available for all years. Arable share of output at current prices: Broadberry et al., *British economic growth*, p. 118. Harvest days per male worker in arable agriculture: harvest days per male worker in arable and pastoral agriculture divided by arable share of output at current prices.

TABLE 6: Employment, wages and labour's share of output in English agriculture, 1250-1850

A. Agricultural employment

	Total population (millions)	Agricultural population (millions)	Agricultural population (1850=100)	Days worked per person	Days worked per person (1850=100)	Total days worked (1850=100)
1250	4.23	2.75	69.9	165	50.0	35.0
1300	4.73	3.07	78.2	165	50.0	39.1
1380	2.44	1.40	35.5	165	50.0	17.7
1400	2.08	1.25	30.3	165	50.0	15.1
1450	1.90	1.06	26.9	165	50.0	13.4
1600	4.11	2.26	57.5	250	75.8	43.6
1700	5.20	2.02	51.5	250	75.8	39.0
1800	8.69	2.75	70.1	330	100.0	70.1
1850	16.73	3.93	100.0	330	100.0	100.0

B. Wage payments and the value of output in agriculture

	Wage rate (d per day)	Wage rate (1850=100)	Wage payments (1850=100)	Output value (£m)	Output value (1850=100)
1250	1.28	5.8	2.0	1.88	2.0
1300	1.32	6.0	2.4	2.25	2.4
1380	2.74	12.5	2.2	2.05	2.2
1400	3.44	15.7	2.4	1.82	1.9
1450	3.82	17.4	2.3	1.69	1.8
1600	7.60	34.7	15.1	12.55	13.3
1700	10.20	46.6	18.2	18.33	19.4
1800	19.00	86.8	60.8	72.57	76.7
1850	21.90	100.0	100.0	94.65	100.0

C. Share of wage payments in agricultural output

	With industrious revolution		Without industrious revolution	
	Wage share of output (1850=100)	Wage share of output (%)	Wage share of output (1850=100)	Wage share of output (%)
1250	103.1	41.2	206.2	82.5
1300	99.1	39.6	198.2	79.3
1380	102.5	41.0	205.0	82.0
1400	123.4	49.4	246.8	98.7
1450	130.9	52.4	261.8	104.7
1600	114.0	45.6	150.4	60.2
1700	93.7	37.5	123.7	49.5
1800	79.3	31.7	79.3	31.7
1850	100.0	40.0	100.0	40.0

Sources and notes: Part A: Population derived from Broadberry and others, *British economic growth*, pp. 20, 227-244 for the period before 1541 and from Wrigley and Schofield, *Population history*, adjusted in line with Wrigley and others, *English population history*, for the period 1541-1850; Agricultural share of population derived from Broadberry and others, *British economic growth*, p. 344. Days worked per person from Broadberry and others, *British economic growth*, p. 264, based on Allen and Weisdorf, 'Was there an industrious revolution?'. Part B: Wage rate from Clark, 'Long march', pp. 99-100. Wage payments derived as total days worked from part A multiplied by the wage rate. Output value from Broadberry and others, *British economic growth*. Part C: Wage share of output, with an industrious revolution, derived in index number form by dividing wage payments in part B with output value and converted to share of output by benchmarking on the 1850 percentage from Clark, 'Growth or stagnation?'. Wage share of output without an industrious revolution derived by repeating the calculations, but with days worked per person held constant at 250 days per year.

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