

REHABILITATING THE INDUSTRIAL REVOLUTION

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REHABILITATING THE INDUSTRIAL REVOLUTION (1)

The historiography of the industrial revolution in England has moved away from viewing the late eighteenth and early nineteenth centuries as a unique turning point in economic and social development. (2) The notion of radical change in industry and society occurring over a specific period was effectively challenged in the 1920s and 1930s by J. H. Clapham and others who stressed the long tap roots of development and the incomplete nature of economic and social transformation. (3) After this it was no longer possible to claim that industrial society emerged de novo at any time between c. 1750 and 1850, but the idea of industrial revolution survived into the 1960s and 1970s. In 1968 Hobsbawm was unequivocal in stating that the British industrial revolution was the most fundamental transformation in the history of the world recorded in written documents. (4) Rostow's work was still widely influential and the social history of what was seen as a new type of class society was only starting to be written. The idea that the late eighteenth and early nineteenth centuries witnessed a significant socio-economic discontinuity remained well entrenched. (5)

It is only in the last decade that the gradualist perspective has appeared to triumph. In economic history it has done so because of a growing preoccupation with growth accounting at the expense of more broadly based conceptualisations of economic change. New estimates have been produced of the growth of industrial output and gross domestic product. They exhibit only very gradual and intermittent increases between 1700 and 1830. Productivity was slow to grow, fixed capital proportions, savings and

investment changed only gradually, workers' living standards and their personal consumption remained largely unaffected before 1830 and were certainly not squeezed. The macro-economic indicators of industrial and social transformation are not present. Thus the notion of industrial revolution has been dethroned altogether leaving instead only a long process of structural change in employment from agrarian to non agrarian occupations.(6) At the same time, and often taking a strong lead from the gradualism of economic history interpretations, the social history of the period has shifted away from analysis of new class formations and consciousness.(7) The post-Marxian perspective stresses the continuity between eighteenth and nineteenth century social protest and radicalism. Chartism, for example, is seen as a chronological extension of the eighteenth-century constitutional attack on Old Corruption.(8) Late eighteenth-century depressions and the Napoleonic Wars are seen as the major precipitators of social tensions which arose from temporary and selective economic hardship rather than from any new radical critique or alternative political economy.(9) 'The ancienne regime of the confessional state' survived the eighteenth and early nineteenth centuries substantially unchanged. (10) In demography, the dominant explanation of the late eighteenth century population explosion stresses the continuity of a much earlier-established demographic regime which remained intact until at least the 1840s. (11) And an influential tendency in the socio-cultural historiography of the last few years has argued that the English industrial revolution was (if it existed at all) very incomplete because the landed aristocracy never gave way in terms of political and economic power to the new industrialism. (12) The middle class in some sense failed. Thus England never had a commitment to industrial growth. The industrial

revolution can be seen as a brief interruption in a great arch of continuity whose economic and political base remained firmly in the hands of the landed aristocracy and its offshoots in metropolitan finance. Gentlemanly capitalism prevailed and the power and influence of industry and industrialists in the English economy and society was ephemeral and limited. (13)

The consensus among historians now points to continuity not revolution yet many contemporaries appear to have had little doubt about the magnitude and importance of change in the period, particularly industrial change. In 1806 Patrick Colquhoun wrote:

It is impossible to contemplate the progress of manufactures in Great Britain within the last thirty years without wonder and astonishment. Its rapidity, particularly since the commencement of the French revolutionary war, exceeds all credibility. the improvement of the steam engines, but above all the facilities afforded to the great branches of the woollen and cotton manufactories by ingenious machinery, invigorated by capital and skill, are beyond all calculation...these machines are rendered applicable to silk, linen, hosiery and various other branches...'(14)

And Robert Owen in 1820 identified a key turning point:

It is well known that, during the last half century in particular, Great Britain, beyond any other nation, has progressively increased its powers of production, by rapid advancement in scientific improvements and arrangements, introduced more or less, into all the departments of productive industry throughout the empire.. The amount of this new productive power cannot, for want of

proper data, be very accurately estimated; butnon will dispute, that its increase has been enormous...

He went on to comment on the social impact of the transformation:

..the natural effect of the aid thus obtained from knowledge and science should be to add to the wealth and happiness of society... All know, however, that these beneficial effects do not exist. On the contrary, it must be acknowledged that the working classes, which form so large a proportion of the population, cannot obtain even the comforts which their labour formerly procured for them, and that no party appears to gain, but all suffer, by their distress. (15)

Have recent approaches obscured important elements of discontinuity which were unique to the late eighteenth and early nineteenth centuries and quite obvious to contemporaries? The aim of this paper is not to turn the clock back to the 1960s but to take stock and re-evaluate the current state of knowledge. We argue that a much more radical transformation took place in the late eighteenth and early nineteenth centuries than is conveyed by recent quantitative assessments. These assessments are based on data and estimates with very wide margins of error, and they also omit much economic activity entirely from their measures, resulting in a tendency to underestimate productivity growth. Furthermore, macro-accounting measures of the economy, even if inclusive, accurate, and exhibiting little growth in productivity cannot prove the absence of fundamental economic and social transformation because such developments are not amenable to study within the frame of reference of national accounts. In other words N. F. R. Crafts and others may not be able to find the industrial revolution because, in addition to using problematic data, they have mis-specified

their subject in identifying it largely with marked discontinuity in trend rates of growth.

We start by indicating some pitfalls of the macro-accounting approach to the industrial revolution. We then examine four areas in which we believe fundamental and unique change occurred during the industrial revolution: technical and organisational innovation, the deployment of female and child labour, regional specialisation and demographic development. We conclude by discussing recent work on the constellation of economic, political and class forces during and after the industrial revolution which has been profoundly influenced by the new gradualist orthodoxy in economic history. We consider the importance for social and political history of our reassessment of the extent and nature of fundamental economic change in these years.

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The macro-economics of the industrial revolution

Deane and Cole were the first to employ national accounts analysis for the period of the industrial revolution. Their calculations led them to stress the long, gradual and faltering progress of British economic growth from the late seventeenth century and to lay primary stress upon the favourable conjunction of population growth, agricultural development and the expanding home market rather than on the more dramatic triad of foreign trade, high capital investment and industrial innovation. Nevertheless Deane and Cole appear to have been in no doubt that a fundamental process of transformation was underway and that this was gathering momentum from the 1780s to the early decades of the nineteenth century when the growth rates of GDP and industrial output (in their estimates) both reached unprecedented levels (around 3% and 4% per annum respectively). (16)

The revised macro-estimates of the last decade find little evidence of industrialisation before the 1830s and 1840s and the continuation of very slow rates of growth even then.(17) Though the new macro interpretations vary a great deal in their explanations of slow growth, all rely on the same sorts of sources and approach in their identification of change. We concentrate here on Craft's work as a way into the more general difficulties of the approach and because it has been the most widely influential in current assumptions about the industrial revolution. (18) Crafts calculated that change in investment proportions was very gradual in the early nineteenth century and that total factor productivity growth in manufacturing was only around 0.2% between 1760 and 1801 and 0.4% 1801-1831. Even total factor productivity growth across the entire economy,

inflated in Crafts' opinion by the performance of agriculture, grew very slowly: 0.2% 1760-1801, 0.7% 1801-31 reaching 1.0% only in the period 1831-1860.(19) Crafts argues that one small and atypical sector, cotton, possibly accounted for half of all productivity gains in manufacturing: it was a modern sector floating in a sea of tradition. He draws the conclusion that ' ..not only was the triumph of ingenuity slow to come to fruition but it does not seem appropriate to regard innovativeness as pervasive.' (20) We believe that this opinion rests on two false assumptions. First it is assumed that the innovative sector functioned independently of, and owed little to, changes in the rest of the manufacturing and service economy. Secondly innovation is assumed to concern only the introduction of capital-intensive plant and equipment which has immediate measurable impact on productivity. We return to these important points about economic dualism and productivity below but first deal with measurement problems of the national accounts approach during the industrial revolution period. These problems alone are sufficient to undermine confidence in the current gradualist orthodoxy.

Measurement problems

Industrial output and GDP are aggregate estimates derived from the weighted averages of their components which, as Crafts himself admits, involves 'a classic index number problem'.(21) The difficulties of assigning weights to industrial and other sectors of the economy, allowing for changes in weights over time and for the effects of differential price changes and value-added changes in the final product are insurmountable and will always involve subjective decisions which can introduce wide margins of error. These in turn become magnified in residual calculations

like that of productivity growth. (22) At the root of problems concerning the composition of the economy by sector in the national accounting framework are the new social and occupational tables of Lindert and Williamson upon which Crafts and others rely.(23) These may be better as a gauge for sectoral weights than the earlier social structure estimates of King, Massie and Colquhoun, but Lindert himself has cautioned that for the large occupational groupings of industry, agriculture and commerce error margins could be as high as 60% whilst estimates for shoemakers, carpenters and others are 'little more than guesses'.(24) Lindert and Williamson rely on burial records as their main source of occupational information, a source very poor in giving occupational information for women and children. Yet we know that women and children were a vital and growing pillar of the manufacturing workforce in this period. The further difficulties of allowing for dual and triple occupations, and of dealing with descriptions like 'labourer', which give no indication of sector, suggest that no reliable sectoral breakdown for labour inputs can be made. Before the 1831 Census, and without the benefit of much more research, not only are sectoral distributions likely to be erroneous, but they are particularly likely to underestimate the role of growing sections of the labour force and of the vitally important overlap between agrarian and industrial occupations.

Nor are the industrial macro-data particularly robust. Many of Crafts' estimates of sector output and inputs rely on using multipliers derived from a handful of examples and only a sample of industries is used. This omits potentially vital sources of output and productivity increase in the economy: for example, food processing, metal-wares, distilling, lead,

furniture and coachmaking and new industries like chemicals and engineering.(25) We must be convinced that the sectors which are included are representative of industry as a whole but our confidence of this is undermined by the fact that the sample is heavily biased in favour of finished rather than intermediate goods. From what we know about change in the nature and uses of raw and semi-processed material inputs this bias may neglect major sources of innovation in the economy.

Several of the industrial output series which Crafts does use have recently been called into question and his uncritical use of customs and excise figures and of statistics derived from very partial and unrepresentative branches of industries has been exposed. It is not surprising that Crafts' compound growth rate for coal in the first half of the eighteenth century is only half that of Flinn's, and that Pollard's estimates of coal output, on which Crafts relies, fall short of Flinn's by between 14 and 24 % for the period 1750 to 1815.(26) These sorts of error margins dog all of Crafts' sectoral output figures, and large areas of economic activity have of course left no easily available source of quantitative data at all. Even in the twentieth century national income accounting used as an indicator of national economic activity has its critics, and the problems of underestimation are magnified in earlier applications because of the relative embeddedness of economic activities in non market relationships. (27) The problems of the national accounting approach are compounded for periods of fundamental economic change because the proportion of total industrial and commercial activity showing up in the estimates over time is likely to fluctuate widely. If, as seems likely, entry thresholds in most industries were very low in the period, industrial expansion might take

place first and foremost amongst a myriad of small firms which have left few records and whose contribution is lost to the historian who confines herself to easily-available indices.

In calculating the size and nature of the service sector the macro-accounting framework encounters a virtually impossible task; Crafts is forced to rely on the assumption that productivity in the service sector increased no more than in industry. Behind this lies the even more problematic assumption that the service sector expanded at the same rate as population before 1801 and in line with what little we know about rents, (central) government expenditure and the growth of the legal profession thereafter. Crafts' account of the service sector excludes direct evidence of what was happening in transport, financial services, retail and wholesale trades, other professions besides law (in other words what was happening to transactions costs), to say nothing of personal and leisure services.(28) More controversy has been caused by Crafts' sectoral estimates for agriculture because for this there is no direct evidence of national output and one must rely on inferences from population growth, agricultural incomes, prices and income elasticities. But all these are themselves unreliable.(29)

Finally, price data for the eighteenth century are sparse and highly partial. This is a problem because, apart from assigning reliable weights to industrial and other sectors of the economy, the national accounts framework requires price information across the board to calculate value added in each sector. These considerations together undermine firm conclusions derived from the current estimates and also indicate a probable

tendency to underestimate production and productivity in the industrial and tertiary sectors of the economy.

With this conclusion in mind, it is worth noting that Crafts' most recent statistical analysis of the industrial output series for Britain, Italy, Hungary, Germany, France, Russia and Austria show that Britain and Hungary were the only countries to exhibit a prolonged period of increases of trend growth in industrial production during the process of industrialisation.(30) Although these increases were unspectacular, this is a remarkable finding in view of Gerschenkron's expectations about the trend rates of growth of late-comers. In the light of the qualitative evidence of the extent and speed of change in Germany and Russia in particular, this finding suggests that either the macro-estimates are so far from accurate to be worthless for this purpose and /or that paying undue attention to changes in the trend rates of growth at national level is not particularly helpful as a starting point for identifying or understanding economic transformation.

Identifying the industrial revolution

Aggregative studies are dogged by an inbuilt problem of identification in posing questions about the existence of an industrial revolution. As Mokyr has pointed out in the English case:

Some industries which grew slowly were mechanising and switching to factories (e.g. paper after 1801, wool and chemicals like soap and candles) while construction and coal mining

in which manual techniques ruled supreme with few exceptions until deep in the nineteenth century, grew at respectable rates.(31)

Clearly technical progress is not growth and rapid growth does not everywhere imply the revolutionising of production functions. Can we justify relying upon a definition of industrial revolution which equates it only with high aggregate investment ratios, high factor productivity manufacturing techniques and their immediate influence on the formal GDP indicators? In answering this question we need to look more closely at the fallacies of the industrialisation model which underpins much current analysis.

The new interpretations of the industrial revolution rely on an analytical divide between the traditional and modern sectors. There was high productivity factory and mechanised industry on the one hand, and a widespread industrial and service sector backwater on the other. It is argued that the large size of the traditional sector, combined with primitive technology made it a drag on productivity growth in the economy as a whole. (32) But it is not clear how helpful this divide is in understanding the economic structure or the dynamism of eighteenth and early nineteenth century England.

The use of a two-sector, traditional/modern model of industrial change is reminiscent of development economics during the 1950s and 1960s which looked to a policy of accelerated and large scale industrialisation through promotion of the modern sector as a spearhead for the rest of the economy.(30) This division was abandoned in the 1970s with the recognition

of diverse and dependent linkages between the traditional or 'informal sector' and the 'modern international sector'.(33) But the division remains strong in economic history: the two sectors are seen either as largely separate or the 'traditional' sector is seen as lagging behind or subordinate to and derivative of factory-based mass production. Thus the dynamism of dispersed, labour using, small firm trades gets lost.(34)

In reality, it is impossible to make clear-cut divisions between the traditional and the modern in the eighteenth century economy, as there were rarely separate organisational forms, technologies, locations or firms to be ascribed to either. Eighteenth and nineteenth century cotton manufacturers serving domestic as well as foreign markets typically combined steam powered spinning in factories with large scale employment of domestic handloom weavers and often kept a mix of powered and domestic hand weaving long after the powered technology became available. This was a function of risk spreading, the problems of early technology and the cheap labour supply of women and children in particular. Thus for decades the 'modern' sector was actually bolstered by, and derivative of the 'traditional' sector and not the reverse. Artisans in the metal-working sectors of Birmingham and Sheffield frequently combined occupations or changed these over their life cycle in such a way that they too could be classified in both the traditional and modern sectors.(35) Artisan woollen workers in West Yorkshire clubbed together to build mills for certain processes and thus had a foot in each of the modern and traditional camps. These so-called 'company mills' underpinned the success of the artisan structure. (36) Thus the traditional and the modern were most often inseparable and mutually reinforcing. Firms primarily concerned with

metalworking, diversified into metal processing ventures as a way of generating steady raw material supplies. This and other cases of vertical integration provide more examples of the tail of tradition wagging the dog of modernity.(37)

The non factory, supposedly stagnant sector often working primarily for domestic markets pioneered extensive and radical technical and organisational change not recognised by the revisionists. The classic textile innovations were all developed within rural manufacture and artisan industry; the artisan metal trades developed skill intensive hand processes, hand tools and new malleable alloys. The wool textile sector moved to new products which reduced finishing times and revolutionised marketing. New forms of putting out, wholesaling, retailing, credit and debt, and artisan co-operation were devised as ways of retaining the essentials of older structures in the face of the new more competitive and innovative environment. Customary practices evolved to combat the needs of more dynamic and market orientated production. The result was considerable transformation even within the framework of the so-called traditional sector.

The revisionists argue that most industrial labour was to be found in those occupations which experienced little change.(38) But these occupations in the food and drink trades, shoe making, tailoring, blacksmithing, and trades catering for luxury consumption successfully expanded to supply the essential urban services on which town life, urban growth and hence much of centralised industry was dependent. It is furthermore the case that early industrial capital formation and enterprise typically combined activity in

the food and drink or agricultural processing trades with more obviously industrial activities creating innumerable external economies.(39) This was true in textile manufacture and in metal manufacture in Birmingham and Sheffield where inn keepers and victuallers were common mortgagees and joint owners of metal working enterprises.(40) Such manufacturers also maintained joint occupations in the metal and food and drink trades. In the south Lancashire tool trades Peter Stubs was not untypical when he first appeared in 1788 as a tenant of the White Bear Inn in Warrington. Here he combined the activity of innkeeper, malster and brewer with that of filemaker using the carbon in barm bottoms (barrel dregs) to strengthen the files.(41) There are many examples of this kind of overlap between services, agriculture and industry. These were the norm in business practice at a time when entrepreneurs' risks were difficult to spread in a blind way through diversification of portfolios and where so much could be gained from the external economies created by these overlaps.

More questionable than their assumption of the separateness and dependence of the traditional sector is the revisionists' understanding of innovation and of the mainsprings of productivity change in the economy at this time.

Innovation and Productivity

Productivity change is much discussed in connection with the industrial revolution but it is seldom clearly defined. The constraints on measures deployed are rarely explained, and measures of limited meaningfulness have been produced and widely accepted on trust. Total factor productivity (TFP) is the measure used by Crafts and others to conclude that productivity was

so slow to grow in the period. It is usually calculated as a residual after the rate of growth of factor inputs have been subtracted from the rate of growth of GDP. There are several major problems with the TFP measure. First, TFP as a residual calculation is subject to the magnified errors of any mistakes in the estimation of sectoral outputs and factor inputs. If the original sector weightings were wrong then TFP becomes highly distorted. Big differences in TFP also occur from variations in the estimated growth of GDP. Secondly, if factor reallocation from sectors with low marginal productivities to those with high ones is an important feature of the period, it will not be possible to derive economy-wide rates of TFP growth simply by taking a weighted average across sectors. The factor reallocation effects must be added on.(42)

Thirdly, TFP embodies a number of restrictive assumptions rarely acknowledged by those who use the measure. These are perfect mobility of factors, perfect competition, neutral technical progress, constant returns to scale, and parametric prices.(43) These assumptions do not reflect the reality of the eighteenth century economy. the assumption of neutral technical progress is suspect in the face of long term empirical evidence of labour saving technical change. So too are assumptions of constant returns to scale against evidence of increasing returns which necessitate adjustments in TFP calculations to allow for imperfect competition and changing elasticities of product demand and factor inputs.(44)

Assumptions of full employment of labour and capital as well as perfect mobility are also inappropriate. Movement of population was not always or even often a response to shortages of labour in industry and indeed many industrial sectors came to be characterised by flooded labour markets

particular for the less skilled tasks. These were matched by massive immobile pools of agricultural labour in many southern and midland counties. Structural unemployment was endemic and chronic underutilisation of both labour and capital was aggravated by seasonal and cyclical swings.(45)

One of the major forms of innovation in the eighteenth century was the product innovation which fuelled the consumer revolution. (46) But because the national accounts framework measures the replication of goods and services, it cannot incorporate easily either the appearance of entirely new goods not present at the start of a time series or improvements over time in the quality of goods, services or labour. New products further dog efforts at productivity estimation through national accounting techniques because the initial prices of new goods are usually very high but decline rapidly as innovation proceeds, making the calculation of both weights and value-added a major problem.(47)

TFP thus takes no account of innovation in the nature of inputs or outputs yet we know that both were marked features of the period. Labour input, for example needs to be adjusted for changes in age, sex, education, skill and intensity of work. Output per worker is also a function of changes in the relative power of employers to extract work effort and of the power of employees to withhold it. (48) Similarly inputs were changing constantly in the period as product innovation affected the nature of raw materials and intermediate goods as well as final products. The small metal trades were a case in point: innovation entailed not powered mechnisation but the introduction of new products and the substitution of cheap alloys for

precious metals in their raw materials. (49) Finally, the national accounts framework cannot measure that qualitative improvement in the means of production which is a necessary pre-requisite to the enjoyment of economic growth through shorter working hours or less arduous or monotonous work routines.(50) Clearly a broader concept of technological change and of innovation is required than is possible within the measures associated with national accounting. If the most sensible way to view the course of economic growth is through the timing and impact of innovation, it is arguable that the introduction of national accounting categories has frustrated this project. Emphasis has been placed on saving and capital formation at the expense of science, economic organisation, new products and processes, market creativity, skills, dexterity, the knacks and work practices of manufacture and other aspects of economic life which may be innovative but have no place in the accounting categories.(51)

The problems involved in measurement of economy-wide productivity growth and in regarding such an aggregate measurement as reflective of the extent of fundamental economic change are compounded when one considers the nature of both industrial capital and industrial labour in the period. Redeployment from agrarian based and domestic sectors to urban and more centralised manufacturing may well have been accompanied by diminishing labour productivity in the short run. Green labour had to learn industrial skills as well as new forms of discipline while, within sectors, labour often shifted into processes which were more rather than less labour-intensive. The same tendency to low returns in the short term can be seen with capital investment in the period. Early steam engines and machinery were imperfect and subject to breakdowns and rapid obsolescence. Gross

gross capital investment figures, (which include funds spent on renewals and replacements) when fed into productivity measures are not a good reflection of the importance and potential of technological change in the period. Rapid technological change is capital hungry as new equipment soon becomes obsolescent and is replaced. Shifts in the aggregate measures of productivity growth are thus actually less likely to show up as significant during periods of rapid and fundamental economic transition than in periods of slower and more piecemeal adjustment. Industrial revolution and economic growth are not interchangeable terms and an industrial revolution is unlikely to be reflected in the short or even medium term in huge rises in productivity, a fact illustrated by the current computer revolution. This point was stressed by Hicks who noted that the long gestation period of technological innovation might yield Ricardo's machinery effect: the returns from major shifts in technology would not be apparent for several decades and, in the short term, innovation would only increase unemployment and put downward pressure on wages. (52) If patenting can be taken as a rough indication of inventiveness then we have some evidence that growth of TFP in nineteenth century England took place some 40 years after the acceleration of inventive patentable activity.(53)

The labour force, and labour discipline

Another striking feature of the new orthodoxy is its restricted definition of the workforce; this in turn is closely related to the analysis of productivity change as well as to the standard of living debate. Wrigley assesses key productivity growth only through the 10% of adult male labour which in 1831 worked in industries serving distant markets. Williamson's documentation of inequality and Lindert and Williamson's survey of the

standard of living consider only adult male incomes whilst Lindert's estimates for industrial occupations rely on adult burial records which are almost exclusively male. (54) But the role of women and children in both capital and labour intensive market orientated manufacturing (in both the 'traditional' and the 'modern' sectors) probably reached a peak in the industrial revolution making it a unique period in this respect.(55)

It is extremely difficult to quantify the extent of female and child labour as both were largely excluded from official statistics and even from wage books. But analyses based only on adult male labour forces are clearly inadequate and peculiarly distorting for this period. On the supply side the labour of women and children was a vital pillar of household incomes, made more so by the population growth and hence the age structure of the later eighteenth century which substantially reduced the proportion of males of working age in the population.(56) The impact of the high dependency ratio was cushioned by children earning their way at an early age particularly in domestic manufacturing. Child and female workers were the key elements in the labour intensity, economic differentiation and low production costs found in late eighteenth century industries. (57)

On the demand side the need for hand skills, dexterity and work discipline encouraged the absorption of more and more female and juvenile labour into commercial production. This was further encouraged by sex differentials in wages which may have been increasing under the impact of demographic pressure in these years.(58) The attraction of both low wages and long hours was very important to employers at a time when no attention was yet paid to the incentive effects of payment by results or shorter hours.(59)

Thus factors on both the supply and the demand side of the labour market resulted in a labour force structure uniquely dominated by high proportions of child and female workers and this in turn influenced and was influenced by innovation. New work disciplines, new forms of subcontracting and putting out networks, factory organisation and even new technologies were tried out initially on a child and female workforce. (60)

Women and children were specifically sought out by employers because they were suitable for a division of labour based on the adult with child assistants. This workgroup grew out of eighteenth century domestic and workshop production but was dramatically expanded in the industrial revolution period to workshops organised under hierarchical division of labour and in factories employing family based work groups. Processes were often broken down into a series of dextrous operations which were performed particularly well by teenage girls who contributed manual dexterity learned at home and high labour intensity. Highly labour intensive techniques such as picotage in calico printing or extensive division of labour as in button making were combined with disciplined workshop production. These processes were not highly mechanised but were supervised closely as in a factory system. (61)

The peculiar importance of youth labour in the industrial revolution is highlighted in several instances of textile and other machinery being designed and built to suit the childworker. The spinning jenny was a celebrated case; the original country jenny had a horizontal wheel requiring a posture most comfortable for children of nine to twelve. Indeed for a time in the very early phases of mechanisation and factory

organisation in the woollen and silk industries as well as cotton, it was generally believed that child labour was integral to textile machine design.(62) This association between child labour and machinery was confined to a fairly brief period of technological change. In the north eastern United States it appears to have dated from around 1812 to the 1830s when women and children as a proportion of the entire manufacturing labour force rose from 10 to 40%. This was associated with new large scale technologies and divisions of labour specifically designed to dispense with more expensive and restrictive skilled adult male labour.(63) This was an important factor in the British case too. The employment of an increasing proportion of female labour in English industries was also encouraged by the ready reserves of cheap and skilled female labour which had long been a feature of domestic and workshop production. In addition, in England, many agricultural regions shed female workers first during the process of agricultural change and much migration within rural areas and from rural to urban areas consisted of young women in search of work. (64)

By mid century this uniquely important role of female and child labour was beginning to decline through a mixture of legislation, the activities of male trade unionists and by the increasingly pervasive ideology of the male breadwinner and of fit and proper female activities. (65) A patriarchal stance was by this time also compatible with the economic aims of a broad spectrum of employers. According to Hobsbawm, larger scale employers (as well as male labour) were learning the 'rules of the game' in which higher payments (by results), shorter working hours and a negotiated terrain of common interests could be substituted for extensive low-wage exploitation with beneficial effects on productivity. (66) It is the earlier phase of

extensive low-wage exploitation of the female and child members of the family in particular which was unique to the industrial revolution.(67) Access to cheap supplies of labour, especially that of women and children was not of course new it was integral to the spread of manufacture in the early modern period. But what was new in the classic industrial revolution was the extent of its incorporation into the most rapidly expanding commercial manufacturing sectors and its association with increased intensification and labour discipline.(68) The female and juvenile workforce undoubtedly had an impact on the output figures per unit of input costs for many industries but this would not necessarily be reflected in aggregate TFP because much female labour was a substitute for male:it increased at times and in sectors where male wages were low or male unemployment high. (69) The social costs of underutilised male labour (felt in high transfer payments through poor relief) were likely to suppress gains in the macro indicators. This suppression was endorsed by the lack of incentive to substitute capital for labour when the labour of women and children was so abundant, cheap, and easily disciplined through family work groups and in the absence of traditions of solidarity. (70)

The full impact of this expanded role of female and juvenile labour can only be fully understood at a disaggregated level by analysing its impact upon sectors and in regions where it was crucially important. The regional perspective is also uniquely valuable for the period in assessing the extent and nature of economic and social change more generally.

The regional perspective

The interactions and self reinforcing drive created by the development of

industry in marked regional concentrations are a major feature of the industrial revolution in England. But this is a qualitative development not adequately captured in the national quantitative indicators. For example an increase in the output of the British wool textile sector by 150% during the entire eighteenth century seems very modest but this conceals the dramatic re-location taking place in favour of Yorkshire whose share in national production rose from around 20% to around 60%. From the aggregate perspective 150% increase over a century could have been achieved simply by gradual extension of traditional commercial methods and production functions. But Yorkshire's intensive growth necessarily embodies a veritable revolution in organisational patterns, commercial links, credit relationships, the sorts of cloths produced and (selectiveley) in production techniques. The external economies to be achieved when one region took over more than half of the production of an entire sector were also of key importance to say nothing of the social implications. (71) The provincial industrial regions of the late eighteenth and early nineteenth centuries were unique in being dominated by particular sectors in a way never experienced before nor to be experienced again after the growth of intra-sectoral spatial hierarchies during the twentieth century. Furthermore, sectoral specialisation and regional integrity together help to explain the emergence of regionally distinctive social and class relations which set a pattern in English political life for over a century. These were important and unique developments of the industrial revolution and prompt the view that regional studies may be of more value in understanding the process of industrialisation than studies of the national economy as a whole.(72)

The main justification which Crafts uses for employing an aggregative approach to identify the nature, causes and corollaries of industrialisation in Britain is that the national economy represented, for many products, a well integrated national goods market by the early nineteenth century. Although the national spread of fashionable consumer goods was increasing and national markets for much bulk agricultural produce were established before the mid eighteenth century, it simply cannot be substantiated before the second quarter of the nineteenth century that the economy had a '..fairly well integrated set of factor markets.'

(73)The really important spatial unit regarding the market for factors, especially capital and labour and for information flow, commercial contacts and credit networks in the pre-railway period and beyond was undoubtedly the often clearly delineated economic region. Construction of the improved navigation and canal systems on which the economic growth of this period depended did much to endorse the existence of regional economies, for a time making them more insular (in relation to the national economy) than before. Waterway networks were largely regionally constructed, were initially financed and promoted within their own region and were intended first and foremost to serve the region's own economy economy.(74)

Where canal systems did connect inter-regionally it was more often with the ports and with the international economy than with the patterns of national trade and influence which flowed through London. And it is no accident that during the period when canal haulage articulated the economy the large commercial cities of the provinces grew most rapidly in relative and absolute terms. Nor were the railways quick to destroy regionally-oriented

transport systems. Most companies found it in their best interests to structure freight rates so as to encourage the trade of the regions they served, to favour short hauls and thus to cement regional resource groupings. (75)

The regional nature of factor markets is illustrated if we take the case of labour. Hunt's recent work on regional wages has gathered evidence of a major and widening shift in differentials in the period 1760-1790s in favour of the northern industrialising regions. This is not consonant with the macro-economic work which assumes that the market will reduce spatial differentials with industrialisation. Hunt sees his findings as more consistent with a growth pole interpretation which predicts that in several respects market forces may operate to reinforce the initial advantages of industrialising regions. The development of external economies and economies of scale will encourage the clustering of new economic activities creating backwash effects in more peripheral regions which prove unable to compete and which lose their most vigorous populations through outmigration. The slow-moving aggregate figures of England's economic performance disguise a great deal of activity of this kind where rapidly expanding and intensively industrialising regions had their counterparts in areas of stagnation or agricultural unemployment. (76)

The markets for both industrial capital and for commercial credit were also firmly regional before the 1830s and 1840s and the region remained an important financial unit well beyond these decades especially before the widespread adoption of the joint-stock form. In the eighteenth and early nineteenth centuries risk capital rarely flowed outside of the

industrialising regions where it was generated and the bulk of finance raised by industrialists came from their locality and its wider region from within a network of commercial social and familial links where face to face knowledge and trust were important. There were regional networks of capital supply articulated in the eighteenth century through the role of attorneys active at the level of the county legal circuit. Land tax collectors, with their important seasonal balances were regionally based and had detailed knowledge of the landed security of their potential short-term borrowers. The banking system throughout the period also had distinctive regional features: the partners, directors and shareholders of banks were overwhelmingly drawn from the immediate locality and it was common for the private banks within each region to bail each other out in time of crisis with declarations of support. The basis of the banking system- the acceptance of each others notes and cheques- was a network of agreements and mutual recognition which was much denser within regions than between them. The banking system also transferred funds from areas of capital surplus to areas of capital need, but the differential interest rates which provided the motive force for this transfer were themselves an illustration of the existence of specifically regional capital markets. The regional nature of commercial crises and waves of bankruptcies provides further testimony of the regional level of the great bulk of financial links during the industrial revolution. (77)

The strength of regional sentiment during the early nineteenth century adds support of the idea of the the emergence of more distinct and integrated regional economies in this period. There occurred a growing identification among all social groups with the economic, social and

political interests of their region. Although this may have been no more important than the other identifications which people were creating based on class, religion, nation or community, it certainly grew and reacted upon the rest. And its source can only be understood in the context of regional levels of economic and political influence and of economic and social integration. Industrialisation accentuated the differences between regions by making them more functionally distinct and specialised. Economic and commercial circumstances were thus increasingly experienced regionally and social protest movements with their regional fragmentation can only be understood at that level and in relation to regional employment and social structures. Issues of national political reform came to be identified with particular regions for example factory reform with Yorkshire, the anti Poor Law campaign with Lancashire and Manchester, currency reform with Birmingham. Often the clearly identifiable industrial region was forged through the links created by growing provincial centres such as Manchester, Liverpool, Birmingham, Bradford, Leeds, Newcastle and Cardiff, and the force of regional integration was made complete by the intra-regional nature of the bulk of migration, by the formation of regionally based clubs and societies, trade unions and employers associations as well as by the growth of the provincial press. (78)

Thus as Pollard has argued, the industrial region of the late eighteenth and early nineteenth centuries came to have a dynamic and operative function and not just a descriptive meaning. Industrial regions generated an interaction which would have been absent if their component industries had not been juxtaposed in this way. Intensive local competition combined with regional intelligence and information networks helped to stimulate

region-wide advances in industrial technology and commercial organisation. And the growth of specialised financial and mercantile services within the dominant regions served to increase the external economies and significantly to reduce both intra-regional and extra-regional transactions costs.(79) But expanding, industrialising regions with their sectoral concentrations were matched by regions of declining industry, and chronic underutilisation of labour and capital. The story of commercialising agriculture was similarly patchy. Thus the macro indicators fail to pick up the regional specialisation and dynamism which was unique to the period and revolutionary in its impact.

Demography

The work of Wrigley and Schofield dominates the population history of this period and illustrates some of the more general problems of causal analysis based on aggregative studies. They have argued that, despite considerable growth in numbers and the disappearance of major crises of mortality, there was no significant discontinuity in demographic behaviour in England between the sixteenth and the mid-nineteenth centuries. (80) The population regime was driven by prudence rather than by pestilence; nuptiality and hence fertility throughout the three centuries varied as a delayed response to changes in living standards as indicated by real wage trends. (81) But the danger in using the various series of national demographic variables to analyse patterns of individual motivation is that national estimates may conflate opposing tendencies in different regions, sectors of industry and among different social groups. Real progress in understanding the mainsprings of aggregate demographic trends will only come with regional, sectoral and class breakdowns which are able to address the possibility

that different sorts of workers or social groups within different regional cultures are likely to have encountered different sorts of stimuli or to have varied in their reaction to the same economic trends creating a range of demographic regimes. (82) We get some evidence that this was in fact the case where vital variables such as illegitimacy rates and age of marriage exhibit enduring spatial patterns over periods which saw considerable changes in economic fortunes.(83) And the Parish reconstitution studies emerging from the Cambridge data-base indicate that the temporal movement of vital variables at local level do not line up well with the movement of the aggregate series. Such diversity casts doubt upon the use of the national series and national averages of vital rates for causal analysis of population change. The most important causal variables in local reconstitution studies range well beyond the movement of real wages. The local economic and social setting, broadly defined, was crucial: including such things as proletarianisation, price movements, economic insecurity, and the nature of parish administration particularly of the poor laws. (84) Despite this, a national cultural norm continues to be stressed with the assumption that regions and localities tend towards it. The result, as displayed in the macro-economic work of Crafts and others, is an excessive preoccupation with national comparisons ('the French versus the English pattern') and with the idea that lower classes and backward regions lag behind their superiors, but eventually follow them on the national road to modernity and progress. (85)

The most recent demographic theorising is in fact moving away from the original Wrigley and Schofield causal argument with its emphasis on the continuity of English population behaviour. Levine has stressed the

effects of proto-industrialisation, proletarianisation and the changing composition of the workforce in creating major change within the demographic regime. (86) This opens the door for a more radical interpretation of the causes of change in the fertility side of the demographic equation during these years. This more radical interpretation has also received some endorsement from Schofield himself in a re-examination of the time series data on change in the age and rate of marriage in the seventeenth and eighteenth centuries. (87) This highlights the need to look more carefully at those structural and institutional changes which resulted in the marked decline in age of marriage in the second half of the eighteenth century. Goldstone's reworking of the Cambridge Group data also points to the importance of a growing group of 'young marriers' in the population of the later eighteenth and early nineteenth centuries: a group which continued to marry young despite the general pressures on real wages during these decades. (88) The fertility debate is thus now at a stage where evidence of radical discontinuity is seeping back into the historiography even at the macro-level. Once one turns to regional and local demographic studies the evidence of considerable discontinuity as well as variety becomes more overwhelming. (89)

The influence of the Wrigley/Schofield approach may also have unjustifiably diverted attention away from the mortality side of the equation and the significant discontinuities embodied in it. The Cambridge Group aggregate data suggests that fertility was two and a half times more important than mortality change in underpinning the population increase of the eighteenth century. (90) But accelerating urbanisation with its substantial mortality

penalty make diachronic studies of the national aggregate population particularly likely to underestimate the importance of mortality changes in relation to fertility. The importance of improvements in urban life expectancy in fuelling population growth is perfectly compatible with significant contemporary shifts in fertility and even with such shifts being apparently more significant at the national level. (91)

The implications of radical structural shifts in the composition and location of the population tend to get lost in the causal explanations derived from the movement of variables at the aggregate level. In demographic analysis this has resulted in the current literature being dominated by fertility rather than mortality and by continuity rather than by discontinuity.

Class analysis and gentlemanly capitalism

The evolution of social class and of class consciousness has long been integral to popular understanding of what was new in the industrial revolution. Growing occupational concentration, proletarianisation, loss of independence, exploitation, deskilling and urbanisation have been central to most analyses of the formation of working class culture and consciousness whilst the ascendancy of Whig laissez-faire political economy has been associated with the new importance of industrialists as a class. (92) But recent economic history has rightly emphasised the complexity of combined and uneven development. Putting out, workshops and sweating existed alongside and were complementary with a diverse factory sector. It no longer possible to speak of a unilinear process of deskilling and loss

of workplace control. The diversity of organisational forms of industry, of work experience according to gender and ethnicity, the importance of composite and irregular incomes and of shifts of employment over the life cycle and through the seasons meant that workers' perceptions of work and of an employing class were varied and contradictory. (93) Nor can one speak of a homogenous group of industrial employers. There was a world of difference between the attitude and outlook of small workshop masters in areas like Birmingham and factory employers in the textile districts. Even within these groups there were variations of response to competitive conditions ranging from outright exploitation to paternalism with many mixtures of the two. There was also a wide range of intermediaries from agents down to foremen and leaders of family work groups to deflect opposition and tension in the workplace. (94) In addition, recent writing has questioned any suggestion of deterministic relationships between socio-economic position and political consciousness.(95) Post structuralist work on language and discourse has further added to the ways in which historians now view the relationship between changing forms of production and distribution and their impact upon society and politics.(96) We also now have a much more sophisticated understanding of the complex interplay of customary and market relationships rather than any simple notion of the latter replacing the former. (97)

Despite the significance of this work there is scope for disquiet if these interpretations are allowed to edge out all idea that the industrial revolution period witnessed radical shifts in social relations and in social consciousness. It is important to realise that much recent social history has been based on an unquestioning acceptance of the new gradualist

view of the economic history of the period which, we have argued, severely underplays the extent of radical economic change and of developments which affected masses of the population in a similar manner. Balanced analyses of the combined and uneven nature of development within industrial capitalism should not obscure the fact that the industrial world of 1850 was vastly different for most workers than it had been in 1750. There were more large workplaces, more powered machines and along with these there was more direct managerial involvement in the organisation and planning of work. A stronger notion of the separation of work and non-work time was evolving partly out of the decline of family work units and of production in the home. Proletarianisation had accelerated and the life chances of a much larger proportion of the population were determined by the market and aggravated by urban mortality and disease. Capitalist wage labour and the working class developed irregularly and incompletely but with greater speed than in earlier centuries, while the regional concentration of similarities of experience of work and of the trade cycle advanced class formation sufficiently to produce social protest and conflict on an unprecedented scale. Furthermore, popular radicalism did embody different sorts of anti-capitalist critiques. The machinery question was important in crowd action in manufacturing areas before and during the Luddite period, and the notion of legitimacy of opposition based on an alternative moral economy is central to our understanding of the eighteenth century. (98) Even the current view of Chartism as fundamentally a constitutional movement is undermined by examination of writing and oratory particularly in the textile districts. Clearly the notion of the new industrial capitalist order as an a-moral system had considerable purchase in the hearts and minds of those involved in popular radical

activity.(99)

Whilst the factory never dominated production or employment nationally it did so sufficiently in certain regions to create widespread identities of interest and political cohesion. And where it did not exist it exercised enormous influence not only in spawning dispersed production, sub-contracting and sweating, but also as a major feature of the imagery of the age. The factory and the machine as hallmarks of the period may have been myth but they were symbolic of so many other changes attendant on the emergence a more competitive market environment and the greater disciplining and alienation of labour. This symbol provided a focus of protest and opposition and was a powerful element in the formation of social consciousness. (100)

Finally, in noting the implications for social history of current views of the industrial revolution, we must consider the prominence recently given to the economic power and political influence of the landed aristocracy, rentiers and merchants in the nineteenth century. (101) This prominence has appeared in the literature alongside and, in part, responding to the new gradualist interpretations of industrial change and industrial accumulation. The major division in the social and political life of nineteenth century England is argued to have been that between the dominant gentlemanly capitalism of the aristocratic and rentier classes and a subordinate industrial capitalism. But how valid is this? Is it yet another aspect of the current historiography which (whilst alerting us to the complexity of industrialisation) diverts attention unduly from the impact of changes in industry and industrial power in the period? The gentlemanly

capitalism thesis has been shown to have overestimated the dominance of rentier and mercantile capital in elite wealthholding patterns and to have overemphasised the separation of interests and cultures between these groups and industrialists. The literature also exaggerates the internal homogeneity and cohesion of gentleman-capitalists on the one hand and industrial capitalists on the other. (102) Furthermore, confining discussion to the period before 1830, or even perhaps 1850, it is much more difficult to minimise the role of industry and industrialists. For the late eighteenth and early nineteenth centuries we do not have the empirical evidence to suggest that the metropolitan economy was the major dynamic behind wealth accumulation, tertiary sector growth or imperial expansion. (103) What we know about the dynamism of industrialising regions, the pattern and finance of their overseas trading and their power in political lobbying in these years suggests otherwise. The metropolitan economy may well have become the locus of service sector growth and of wealth accumulation by the third quarter of the nineteenth century but in the industrial revolution period itself it is more likely that regional industrial expansion dictated the course of structural change and imperialism. (104)

Thus although capitalist development was combined and uneven giving rise to a complicated mass of differing perceptions and social relations, many innovations were common to all industries and changes in markets, and in the competitive climate had an impact on all English capitalists. This was the case whether they were metropolitan or provincial and whether financiers, farmers, small masters, factory employers or involved in the service sector.

Conclusion

The industrial revolution was an economic and social process which added up to much more than the sum of its measurable parts. The period saw the sectoral specialisation of regions and the growth of regionally integrated economies some of which were clearly experiencing an industrial and social revolution, no matter how this term is defined, whilst others deindustrialised. The movement of aggregate quantitative indicators ignores this and does not, as presently calculated, give an accurate account of the structural shift in the nature and deployment of the workforce because the calculations rely on adult male labour. The nature of innovation and of productivity change in the period is also currently misrepresented and underestimated. As long ago as 1969 D. S. Landes warned of masking the significance of discontinuities by concentrating on the absence of shifts in macro-economic indicators:

The census returns and other numbers to be found between the covers of the dusty parliamentary papers are the economic historians' butterfly under glass or frog in formaldehyde - without the virtue of wholeness to compensate for their lifelessness. As described by occupational data, the British economy of 1851 may not seem very different from that of 1800. But these numbers merely describe the surface of the society - and even then in terms that define away change by using categories of unchanging nomenclature. Beneath this surface, the vital organs were transformed; and though they weighed but a fraction of the total - whether measured by

people or wealth- it was they that determined the metabolism of the entire system. (105)

It is time to move on from the macro accounting framework and to pull aside the veil of continuity and gradualism which this has imposed. We need to adopt a broader concept of innovation, to insist on a greater awareness of female and child labour and to rebuild the national picture of economic and social change from new research at regional and local level. If this is done, a rehabilitation of the industrial revolution will not be long delayed.

FOOTNOTES

1. Some of the arguments in this article appear in Maxine Berg, 'Revisions and revolutions'; and in Pat Hudson ed., Regions and Industries. We are very grateful to N.F.R. Crafts for detailed discussion of the substance of an earlier version, and to seminar groups at the Institute of Historical Research, London, the Northern Economic Historians Group, University of Manchester, the University of Glasgow and the University of Paris VIII at St. Denis. Although many of the arguments in the paper apply as much to Scotland and Wales as to England, we confine discussion in this paper to the industrial revolution in England in order to avoid confusions which dog much of the literature on the industrial revolution in Britain.
2. For a broad survey of this and other trends in the historiography of the industrial revolution see Cannadine, 'The past and the present'.
3. Clapham is most often associated with initiating the trend away from more cataclysmic interpretations in Economic history of modern Britain, but the shift in emphasis is obvious in other works of the interwar period and earlier, e.g. Mantoux, The industrial revolution, Heaton, 'Industrial revolution', Redford, 'Economic history of England, Knowles, Industrial and commercial revolutions, and George, England in transition.
4. Hobsbawm, Industry and empire, p. 13.
5. Thompson's, Making of the English working class identified the industrial revolution period as the great turning point in class formation. Rostow's, Stages of economic growth, though challenged over the precise fit between the model and British experience was a powerful voice in favour of significant and unprecedented economic discontinuity. Landes drew a convincing picture of the transformations initiated by technical innovation in Unbound Prometheus.
6. Crafts, British economic growth. See also Harley, 'British industrialisation'; McCloskey, 'Industrial revolution', Feinstein, 'Capital formation in Great Britain'; Lindert and Williamson, 'English workers living standards'.
7. Characterised by Thompson, Making, and emphasised by Foster, Class struggle.
8. Stedman Jones, 'Rethinking chartism'.
9. Williams, 'Morals'; Stevenson, Popular disturbances pp. 118, 152; Thomis, Luddites, chap. 2. For critiques of this literature see Charlesworth and Randall, 'Comment' and Randall, 'Philosophy of Luddism'. For a balanced survey of the debate on the 'moral

economy' see Stevenson, 'Moral economy'.

10. The phrase is from Clark, English society which is heavily critical of the social history of the 1970s and 1980s. For a critique of his position, see Innes, 'Jonathon Clark'.

11. Wrigley and Schofield, Population history. The argument is summarised in Wrigley, 'Growth of population' and in Smith, 'Fertility and economy'.

12. See Weiner, English culture; Anderson, 'Figures of descent', Cain and Hopkins, 'Gentlemanly capitalism', Ingham, Capitalism divided?; Leys, 'Formation of British capital'. For the argument that the landed aristocracy was an elite closed to new wealth see Stone and Stone, Open elite?; Rubenstein, 'New men'.

13. *ibid.* The term 'great arch' is from Corrigan and Sayer, The great arch although this work itself does not place exclusive stress on continuity.

14. Colquhoun, Treatise on population.

15. Owen, Report to the Country of Lanark, pp. 246-7.

16. Deane and Cole, British economic growth.

17. Crafts, British economic growth; Williamson, 'Why was British economic growth', and McCloskey, 'The industrial revolution'.

18. Whereas Crafts stresses the low productivity of the economy because of a shortage of high return investment opportunities, Williamson argues that the industrial revolution was crowded out by the effect of war debts on civilian accumulation. For recent debate between these two views see Crafts, 'British economic growth', Williamson, 'Debating' and Mokyr, 'Has the industrial revolution been crowded out?' See also Williamson, 'English factor markets'; Heim and Morowski, 'Interest rates'.

19. Crafts, British economic growth, pp. 31, 81, 84.

20. *ibid.*, p. 87.

21. *ibid.*, p. 17.

22. Jackson, 'Government expenditure'; Mokyr, 'Has the industrial revolution been crowded out?', p. 306.

23. Lindert and Williamson, 'Revising England's social tables'; Lindert, 'English occupations'.

24. *ibid.*, p. 701.

25. Crafts, British economic growth, pp. 17-27.
26. Hoppit, 'Understanding the industrial revolution', p. 216, and 'Counting the industrial revolution', p. 10.
27. For discussions of the problems of national income accounting see Hawke, Economics, pp. 27-36; Usher, Measurement of growth; passim. For discussion of the embeddedness of economic activity see Polanyi ed., Trade and market, pp. 239-306; Douglas and Isherwood, World of goods, Beneria, 'Conceptualising the labour force.'
28. Hoppit, 'Counting', p. 13; Price, 'What do merchants do?'; Jackson, 'Government expenditure', *idem.*, 'Structure of pay'.
29. Crafts, British economic growth, pp. 38-44, Mokyr, 'Has the industrial revolution been crowded out?', pp. 305-312; Jackson, 'Growth and deceleration'; Hoppit, 'Counting', p. 15.
30. This analysis employs the Kalman filter to eliminate the problem of false periodisation and to distinguish between trend changes and the effect of cycles of activity. See Crafts, Leybourne and Mills, 'Economic growth'; and *idem.*, 'Trends and cycles'.
31. Mokyr, 'Has the industrial revolution been crowded out?', p. 314; Hauseman and Watts, 'Structural change', pp. 400-410.
32. Crafts, British economic growth, chap. 2, Mokyr, Economics of the industrial revolution, pp. 5-6; Crafts, 'British industrialisation'.
33. The use of a two sector traditional/modern model of industrial change is reminiscent of development economics during the 1950s and 1960s which looked to a policy of accelerated and large scale industrialisation through promotion of the modern sector as a spearhead for the rest of the economy. This division was abandoned in the 1970s with recognition of the diverse and dependent linkages between the 'formal' and 'informal' and between the 'traditional' and 'modern' sectors, yet it has gained renewed prominence in economic history. See Moser, 'Informal sector', p. 1052; Toye, Dilemmas in development. For fuller discussion of parallel ideas in development economics. See Berg, 'Revisions and revolutions', pp. 17-21. For a particular interpretation of the dynamism of the small firm sector see Sabel and Zeitlin, 'Historical alternatives', pp. 142-156. Cf discussion of debate on this issue in Berg, 'Will the real bosses?'.

34. Berg, 'Revisions and revolutions', pp. 22-28; idem., Age of manufactures, chap. 11. 12
35. Sabel and Zeitlin, 'Historical alternatives', pp. 146-150. Lyons, 'Vertical integration'; Berg, 'Commerce and creativity', p. 30; idem, 'Revisions and revolutions'.
36. Hudson, Genesis of industrial capital, pp. 70-80; idem., 'From manor to mill'.
37. Heaton, Yorkshire woollen and worsted industry; Wadsworth and Mann, Cotton trade; Hamilton, English brass and copper industries; John, Industrial development of South Wales.
38. Crafts, British economic growth, p. 69; Wrigley, People, cities and wealth, pp. 133-157; idem., Continuity, chance and change, p. 84.
39. Jones, 'Environment'; Burley, 'Essex clothier', Chapman, 'Industrial capital'; Mathias, 'Agriculture and brewing'.
40. Maxine Berg, Probate and insurance records in the metal trades of Birmingham, Sheffield and South Lancashire, research in progress.
41. Ashton, Eighteenth century industrialist, pp. 4-5.
42. Williamson, 'Debating', p. 270. Also Mokyr, 'Has the industrial revolution been crowded out?', pp. 305-12.
43. Link, Technological change.
44. Eichengreen, 'What have we learned', pp. 29-30; Link, Technological change, p. 14.
45. Eichengreen, 'Causes of British business cycles'; Allen, Enclosure, chap. 12; Hunt, 'Industrialisation and regional inequality'.
46. Brewer, McKendrick, Plumb, Birth of a consumer society' Breen, T., 'Baubles of Britain'.
47. Usher, Measurement, pp. 8-10.
48. Link, Technological change, p. 24; Eichengreen, 'What have we learned', pp. 29-30; Elbaum and Lazonick, Decline of the British economy, pp. 1-17; Lazonick, 'Social organisation', p. 74.
49. Berg, Age of manufactures, chaps 11,12; Rowlands, Masters and Men.

50. Usher, Measurement, p. 9.
51. *ibid.*, p. 10
52. Hicks, Theory of economic history, p. 153; cf. Berg, Machinery question, chap. 4.
53. Sullivan, 'England's "age of invention"', p. 444; cf. Macleod, Inventing the industrial revolution.
54. Wrigley, Continuity, pp. 83-87; Williamson, Did British capitalism, *passim.*; Lindert and Williamson, 'English workers'
55. Crafts, British economic growth, pp. 4-5. In the woollen industry women's and children's labour accounted for 75% of the workforce, and child labour exceeded that of women and of men. Women and children also predominated in the cotton industry; children under 13 made up 20% of the cotton factory workforce in 1816; those under 18, 51.2%. The silk, lace making and knitting industries were also predominantly female, and there were even higher proportions of women and children in metal manufactures such as the Birmingham trades. See Randall, 'West country woollen industry', vol. 2, p. 249; Nardinelli, 'Child labour', pp. 739-755; Berg, 'Women's work', pp. 70-73; Berg, 'Child labour', Pinchbeck, Women workers, *passim.* Saito, 'Other faces', p. 183; and *idem.*, 'Labour supply behaviour', pp. 636 and 646. For a recent critical discussion of child labour and unemployment see Cunningham, 'Employment and unemployment', *passim.*
56. Children aged 5-14 probably accounted for 23-25% of the total population in the early nineteenth century, compared with 6% in 1951. Wrigley and Schofield, Population history, Table A3.1, pp. 528-9.
57. Berg, Age of manufactures, chap. 6; Medick, 'Proto-industrial family economy', Levine, 'Industrialisation and the proletarian family', p. 177.
58. Saito, 'Other faces', p. 183; *idem.*, 'Labour supply behaviour', pp. 634.
59. Hobsbawm, 'Custom, wages and workload', p. 353, 355.
60. Berg, 'Women's work', pp. 76-88.
61. Berg, Age of manufactures, pp. 146, 249. For modern third world parallels see Pearson and Elson, 'Subordination of women'; and Pearson, 'Female workers'.

62. See. S.C. on children's employment, pp. 279, 343; S.C. on children in factories, p. 254. The issue is explored in greater depth in Berg, 'Child labour' and Berg, 'Women's work'.
63. Goldin and Sokoloff, 'Women, children and industrialisation', p. 747; Goldin, 'Economic status of women'.
64. Pollard, 'Labour', p. 133; Bythell, Sweated trades; Berg, 'Women's work'; Allen, Enclosure, chap. 12; Snell, Annals, chaps. 1 and 4.
65. Lown, 'Women and industrialisation', chap. 6; Seccombe, 'Emergence of male breadwinner'; Rose, 'Gender antagonism'; Davidoff and Hall, Family Fortunes; Harrison, 'Class and Gender', pp.122-138, 145; Roberts, Women's Work.
66. Hobsbawm, 'Custom, wages and workload'; p. 361.
67. Levine, 'Industrialisation and the proletarian family', pp. 175-179; Levine, Reproducing families, pp. 112-115; The low wage character of the export oriented economies of the industrialising regions is highlighted by Lee, The British economy, pp. 131, 136-141. cf. Hunt, 'Industrialisation', pp. 937-45.; Mokyr, echoing Marx suggests that low wages may have been a key factor behind the growth of modern industry: 'Has the industrial revolution been crowded out?', p. 318.
68. Bienefeld, Working hours, p. 41. For parallels with the third world see Pearson, 'Female workers'.
69. Saito, 'Labour supply behaviour'; p. 645-6. Goldin and Sokoloff, 'Relative productivity hypothesis', pp. 461-487. For a standard theoretical and empirical treatment of this see Mincer 'Labour force participation' and Greenhalgh, 'A labour supply function'.
70. Lewis, 'Economic development', p. 404; Allen, Enclosure, chap. 12; Boyar, 'Old Poor Law'; Lyons, 'The Lancashire cotton industry'; Berg, 'Women's work'.
71. The argument here and throughout this section is much influenced by Pollard, Peaceful conquest, chap. 1.
72. Fuller discussion of this can be found in Hudson, Regions, ch.1 and in 'A new "history from below": computers and the maturing of local and regional history: unpublished address given to the Association of History and Computing Annual Conference, April 1990. Wolverhampton Polytechnic.
73. Crafts, British economic growth, p. 3

74. Freeman, 'Transport', p. 86; Langton, 'Industrial revolution and regional geography', p. 162; Turnbull, 'Canals', pp. 537-60.
75. Freeman, 'Transport', p. 92; See also Hawke, Railways.
76. Hunt, 'Industrialisation and regional inequality'; idem. 'Wages', pp. 60-8; Allen, Enclosure, chap. 12; Williamson, 'English factor markets'.
77. All points in this paragraph are substantiated for the West Riding textile region in Hudson, Genesis. Also see Pollard, Peaceful conquest, p. 37; Presnell, Country banking, pp. 284-343; Anderson, 'Attorney and the early capital market'; Hoppit, Risk and Failure, chap. 15.
78. Langton provides a stimulating survey of the regional fragmentation of trade unions, of Chartism and other movements, and of regional differences in work practices and work customs, in 'Industrial revolution', pp. 150-5. See also D. Read, English provinces; cf. Southall, 'Towards a geography' which concentrates on the artisan trades.
79. See Pollard, Peaceful conquest, pp. 19, 28-29.
80. Wrigley and Schofield, Population history, chaps. 10, 11. For summaries of their causal analysis see Smith, 'Fertility, economy and household formation'; Wrigley, 'The growth of population'.
81. There has been considerable debate over this view and the statistical method underlying the analysis. See Gaunt, Levine and Moodie, 'Population history'; Anderson, 'Historical demography', Mokyr, 'Three centuries of population change', Olney, 'Fertility'; Lindert, 'English workers' living standards, population growth'; Lee, 'Inverse projection'; idem., 'Population homeostatis'..
82. See Levine, in Gaunt, Levine and Moodie, 'Population history', p. 155.
83. See for example, Levine and Wrightson, 'Social context of illegitimacy', pp. 160-1; Wilson, 'Proximate determinants'.
84. Wrightson and Levine, Poverty and piety. For the importance of the local economic setting see Levine, Family formation. For family reconstitution results see Wrigley and Schofield, 'English population history'.
85. Seccombe, 'Marxism and demography', p. 35.
86. Levine, Reproducing families, chaps. 2, 3; idem., 'Proletarian family', pp. 181-8 and *passim*.

87. Schofield, 'English marriage patterns'. This study finds that, in the eighteenth century, age of marriage became more important than variation in celibacy in accounting for changes in fertility, and that age of marriage was relatively unresponsive to real wage indices after 1700.
88. Goldstone, 'Demographic revolution'.
89. Levine, Family formation; Jackson, 'Population change in Somerset-Wiltshire'.
90. Wrigley, 'Eighteenth century population growth', pp. 126-33.
91. Woods, 'Population redistribution';. This point is made in Kearns, 'Urban penalty'; cf. Thompson, The Making, pp. 356-366; Perkin, Origins.
92. Foster, Class struggle; Prothero, Artisans and politics; Morris, Class and class consciousness; Seed, 'Unitarianism'.
93. Joyce, Work, idem., 'Introduction', Historical meanings; Samuel, 'Workshop'; Sabel and Zeitlin, 'Historical alternatives'; Reid, 'Politics and economics'; Hobsbawm, 'Marx and history'.
94. Davidoff and Hall, Family fortunes; Behagg, Production and politics; Rodger, 'Mid Victorian employers'; Joyce, Work; Huberman, 'Economic origins of paternalism'; cf. Rose, Taylor, Winstanley, 'Economic origins...objections'; and Huberman, 'Reply'.
95. Stedman Jones, 'Rethinking Chartism';
96. Stedman Jones, *ibid.*; Sewell, Work and revolution; Sonenscher, Work in France; Foster, 'Declassing of language'; Gray, 'Deconstruction of the English working class'; idem., 'Language of factory reform'; Reddy, Money and liberty; Scott, Gender and history, chaps. 1-3; Patterson, 'Post-structuralism'.
97. Williams, 'Custom'; Bushaway, By rite, Randall, 'Industrial moral economy'; Berg, ed., Markets and manufacture.
98. Randall, 'Industrial moral economy'; idem., 'Philosophy of luddism'; Behagg, 'Democracy of work'; Gray, 'Languages of factory reform'; Hilton, Age of atonement. For the impact of similar views on small manufacturers see Davidoff and Hall, Family fortunes.

99. Kirk, 'Defence of class'; Foster, 'Declassing language'.

100. Berg, Machinery question; cf. idem. 'Progress and providence'; Behagg, Politics and production; Randall, 'Industrial moral economy'.

101. This interpretation is seen in varying form in the following works: Cain and Hopkins, 'Gentlemanly capitalism'; Anderson, 'Figures of descent'; Wiener, English culture, Ingham, Capitalism divided.

102. Daunton, 'Gentlemanly capitalism'; Gunn, 'Failure of middle class'; Barrat Brown, 'Away with great arches'.

103. As has been suggested for the mid and later nineteenth century by Lee in 'Service sector'.

104. Porter, 'Capitalism and empire', Allen, Enclosure, chap. 12; Hudson, Regions, chap. 1.

105. Landes, Unbound prometheus, p. 122.

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