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THE PATRIARCHAL PERSPECTIVE: A CRITIQUE OF
THE HIGH WAGE ECONOMY INTERPRETATION OF
THE BRITISH INDUSTRIAL REVOLUTION***

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PATRIARCHAL PERSPECTIVE: A CRITIQUE OF THE HIGH WAGE
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REVOLUTION***

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Abstract

The newly dominant interpretation of the British industrial revolution contends that Britain was a high wage economy (HWE) and that the high wages themselves caused industrialization by making profitable labour-saving inventions that were economically inefficient in the context of other relative factor prices. Once adopted these macro inventions put Britain on a growth path that transcended the trajectories associated with more labour-intensive production methods. This account of the HWE economy is misleading because it focuses on men and male wages, underestimates the relative caloric needs of women and children and bases its views of living standards on an ahistorical and false household economy. A more realistic depiction of the working-class family in these times provides an alternative explanation of inventive and innovative activity based on the availability of cheap and amenable female and child labour and thereby a broader interpretation of the industrial revolution.

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One cold winter morning in early nineteenth-century Essex, an agricultural labourer's family awoke to find they had no food in the house. While the mother swallowed her pride and went to tell the parson "how she was situated", Bill, the oldest son, begged a local farmer to let him dig up some frozen turnips. Bill H_____ and his siblings were attempting to defrost the scavenged roots, when his mother returned with "a lap-ful of broken victuals" and the family was saved. This vivid glimpse of early-nineteenth-century penury has survived because of Bill's ability, despite his lack of schooling, to write a memoir with sufficient authenticity and flair that it caught the eye of the editor of *Macmillan's Magazine*, where it was published anonymously in 1861.² The episode appears in the third paragraph of Bill's memoir, and follows a description of the poverty of his family and its economic and demographic causes:

"I was born at Wimbush, near Saffron Walden, in Essex. My father was a labouring man, earning nine shillings a week at the best of times; but often his wages were reduced to seven shillings.

There was a wonderful large family of us --- eleven was born, but we died down to six. I remember one winter, we was very bad off, for we boys could get no employment, and no one in the family was working but father. He only got fourteen pence a day to keep eight of us in firing and everything. It was a hard matter to get enough to eat."

Bill's family circumstances are presented as in no way unusual. They are replicated many time over in other accounts of working-class life at this time, and square with the consensus among poor law historians that 'the evidence of acute poverty in the last decades of the old poor law is overpowering'.³ Yet such micro history stands in sharp contrast to the new meta narrative of the industrial revolution, which confidently contends that Britain was a high-wage economy (HWE) and that the high wages themselves caused industrialization. The model is seductively simple. Robert Allen, its leading proponent, uses real wage series for eighteenth-century London labourers and craftsmen, to argue that British wages were high in four different ways: relative to the past; relative to the rest of the world including continental Europe; relative to the price of capital; and relative to the price of coal.⁴ The resulting factor price frontier meant that contemporary inventions, although derived from scientific

² Bill H_____, 'Autobiography of a navy'.

³ For accounts of poverty in working-class memoirs, see Vincent, *Bread*, and Humphries, *Childhood*; for the view of poor law historians, see King, *Poverty and welfare*; the quotation is from a classic account, Taylor, *The problem of poverty*, p. 24.

⁴ The development of Allen's version of the HWE hypothesis can be traced from its original inception in 'The Great Divergence' through to his 2009 monograph *The British industrial revolution*, which is précised in his Tawney Lecture, 'Why the industrial revolution was British'.

discoveries shared with mainland Europe, could only yield profits in Britain. Therefore, they were only developed and made operational in Britain. Within this paradigm of industrialization, the famous inventors, those great golden men of the industrial revolution, continue to be celebrated, but their real contribution lies not in technological genius but in seizing the opportunities created by relatively cheap capital and fuel to dispense with relatively expensive labour. Allen's story is that the key inventions of the industrial revolution, the spinning jenny, the steam engine and the smelting of iron ore using coal, were only economically viable where it made sense to substitute relatively cheap capital and coal for relatively expensive labour. Once adopted, these macro inventions put Britain on a growth path that transcended the trajectories associated with more labour-intensive production methods, and the rest is history!

Although Allen's refurbishment and relocation of the Habakkuk thesis has some critics,⁵ in general, it has carried all before it to become the mainstream account of the early twenty-first century. Now that the dust has settled, however, new problems emerge. While it is probably true that relatively high British wages disadvantaged industries such as cotton in comparison with (say) Indian competitors and induced the adoption of more capital-intensive production methods,⁶ the claim that wages at the end of the eighteenth century were historically high and provided a living standard "far above bare bones subsistence" is more contestable.⁷ My criticism concerns perspective and methodology. I argue that the account of the HWE is misleading because it focuses on men and male wages, underestimates the relative caloric needs of women and children and bases its view of living standards on an ahistorical and false household economy. The criticism is developed in five stages: the first uses Allen's own exemplar working-class household to come to very different preliminary conclusions; the second establishes the building blocks of the high wage economy in terms of men's earnings and a poverty line based on minimal standards; the third looks in detail at the definition of this poverty line and particularly the required conversion of women and children to adult-male-equivalents; the fourth constructs a more reasonable and historically-grounded working-class household economy; and

⁵ For the original formulation of the Habakkuk thesis see, Habakkuk, *American and British technology*; see also, David, *Technical choice*. For important critiques of Allen's account see Hudson, 'Review'; Mokyr, *The enlightened economy*; and Kelly, Mokyr and Ó'Gráda, 'Precocious Albion'.

⁶ Broadberry and Gupta, 'Lancashire'; note, however, that Indian competitors were largely excluded from domestic and colonial markets where the bulk of cottons were sold and factors other than price competitiveness such as design, colour and speed of delivery were important in consumer goods markets.

⁷ Allen, *The industrial revolution*, p. 29; considerable evidence exists to suggest that neither real wages nor living standards rose monotonically through the eighteenth century. Most recently, Muldrew in *Food* has raised questions about the comparison between the early and late eighteenth century, and Allen's own work acknowledges a climacteric in real wages in the late eighteenth and early nineteenth centuries, see Allen, 'Engels' Pause'.

the fifth uses this to ground an alternative explanation of inventive and innovative activity based on the availability of cheap and amenable female and child labour and thereby a broader interpretation of the industrial revolution.

I

An earlier (and for many years dominant) interpretation of the industrial revolution based on an aggregate quantitative analysis was criticised by two distinguished regional economic historians for being too aggregative and exclusively quantitative.⁸ Perhaps to forestall such criticism, or to enliven the text for undergraduate consumption, Allen initially avoids an exclusively aggregate perspective. He sets up his (high) wage series with reference to contemporary studies of working-class household budgets. “Budget studies from the industrial revolution confirm the high standard of living”⁹ Reference here is to Sir Frederic Eden’s 3 volume enquiry into *The State of the Poor*.¹⁰ Out of the 53 budgets that Eden documents, Allen chooses the forty-year-old gardener living in Ealing (then just outside London) with a wife and four young children,¹¹ which he holds to be “[A] typical example”.¹² Allen describes the gardener as, by combining jobs, managing to earn 30p per day (15s a week) “which was a labourer’s wage in London in the 1790s”.¹³ This wage delivered a comfortable living standard: the gardener could afford meat, tea and sugar, schooling for older children, coal for winter fuel and rent of a house with garden. He was, according to Allen, “living towards the top of Engels’ meat scale and far above bare bones subsistence”.¹⁴ However, Allen does not use the Ealing gardener’s budget to argue about wages and living standards by combining it with other analogous accounts.¹⁵ It is cited only to anticipate findings from the aggregate analysis of wages: for support not illumination. “Representativeness of budgets like this is of course a question. We will address this later by calculating what people could afford to buy with the incomes they earned. The calculations confirm that the lifestyle of the Ealing gardener was within the reach of many Brits”.¹⁶ A methodological divide opens between work which attempts to aggregate from the bottom up to check on the representativeness of the average account and work which cherry picks individual cases to support findings from other (perhaps more conventional) sources.

⁸ Berg and Hudson, ‘Rehabilitating’.

⁹ Allen, *The industrial revolution*, p.29.

¹⁰ Eden, *The state*; for a discussion of the representativeness of Eden’s budgets, see Brunt, ‘The advent of the sample survey’.

¹¹ Eden, *The state*, pp.433-5

¹² Allen, *The industrial revolution*, p.29.

¹³ Allen, *The industrial revolution*, p.29.

¹⁴ Allen, *The industrial revolution*, p. 29.

¹⁵ For such an approach, see Horrell and Humphries, ‘Old questions’.

¹⁶ Allen, *The industrial revolution*, p. 29.

Before leaving the Ealing gardener, his case deserves closer attention, chosen as it was for its alleged typicality. It is worth quoting Eden in full:

“The following are the earnings and expenses of a labourer, aged about 40, employed regularly throughout the year in a gentleman’s fields and gardens. His weekly wages are 11s, but sometimes he works by the piece, when he makes 3s. a day easily. His hours of work are in summer from 6 to 6, in winter from day-light to dark. He has a wife and four children (2 boys aged 8 and 6, two girls 4 and 1½). Earnings: Regular weekly wages annually, £28 12s: extra by piece work from employer, £6; ditto from other people, after usual work hours, £3. His wife does a little work in hay harvest about £1. Total £38 12s. Expenses: Rent for a cottage and small garden, £3 18s. His family consume a quartern loaf of bread a day, which at 10d comes to £15 3s and 4d.; meat £4 11s.; small beer, 4 quarts at 6d. weekly, or yearly £1 6s.; cheese, £1; estimated consumption of tea, 2oz. a week, at 4s. per lb.; sugar at 9d.; soap, ½lb. weekly at 9d.; candles, about 10s, or altogether, £6 7s.; coals, one bushel a week at 1s. 6d., which for 26 weeks is £1 19s. He uses two pairs of shoes a year (7s 6d. each, 1s mending), or yearly 16s; 3 pairs of stockings (2s. A pair), 6s.; an old coat about 7s.; shirts, 10s.; other articles, 10s.; yearly expenditure on clothes, £2 9s. His wife’s clothes not more than £1 1s. The two eldest children learn to read at a day school at 3d. a week, each £1 6s. Total expenses, £39 0s. 4d. Nothing is charged for clothing the children, as the wife contrives to provide them from her husband’s old clothes, and from presents of linen which she receives on lying-in, etc. The man is allowed from his master’s garden what potatoes and other vegetables he has occasion for, and about a quart of skim milk from the dairy every morning. Notwithstanding, he complains heavily of the hardness of the times, and says his earnings are barely sufficient to pay his expenses. He is now asking for an increase in wages”.¹⁷

The extended account certainly shades the sketch offered to illustrate the HWE. The subject is both a gardener and an agricultural labourer. His regular wages are in fact only 11s not 15s a week and it is only sometimes that he has access to the piecework, which boosts his earnings. Moreover these extras involve him working “after usual hours”—hours already revealed as from “6 to 6” or “daylight to dark”, that is after a 12 hour day. Gifts from the man’s employer and access to a cottage garden appear crucial to the range and sufficiency of the diet. The clothing budget is hugely problematic; apparently the children would go naked to school were it not that the wife’s cleverness with her needle enables her to manufacture apparel for them out of the gardener’s cast-offs and gifts of linen from her lying in. Her clothes budget is also squeezed and there is no provision for a midwife or other care during childbirth. The Ealing gardener himself fails to appreciate that he is part of a HWE, complaining

¹⁷ Eden, *The state*, pp. 433-5.

about hard times and wanting a pay increase. I cannot help but wonder what his wife might have added!

II

Close inspection of one account whose representativeness is moot, cannot get us very far and indeed Allen's methodology is very different. He defines living standards as the quotient of average wages and the cost of various consumption bundles that represent different standards of living, beginning with a subsistence bundle. Thus, the building blocks for the HWE include: building labourers and craftsmen's wages, (in much of Allen's work converted into grams of silver to facilitate international comparisons); baskets of consumption goods representing subsistence and respectable living standards, (again often converted to grams of silver); and, since the consumption baskets delivering living standards are defined for a single adult male, conversion factors to convert families of an assumed size and structure to adult male equivalents. It is not my aim to question the wages data, which are well-known series, though since they relate primarily to London, they likely tell a more positive story than a series for a peripheral rural county or a more disadvantaged occupational group. Agricultural labourers constitute a sensible comparator since they remained the largest single occupational grouping and one known to have fared less well over the course of the industrial revolution.¹⁸ Here the focus is on those other building blocks of the HWE: the construction of a poverty line consumption bundle, and particularly its extension from an individual wage earner to the consuming unit of a family, which involves reducing women and children to adult male equivalents and making assumptions about the size and structure of working-class families.

In earlier articles, Allen constructs a subsistence basket in terms of the cheapest foodstuffs needed to secure a minimum caloric intake set at 1941 kcals/day.¹⁹ The cost of this basket establishes the poverty line. More recently, while reaffirming this benchmark, Allen also sketches a superior standard, which includes a more generous allowance of bread and so raises the daily consumption of calories from 1941 to 2500.²⁰ Again, the cost provides a yardstick though now for "respectability", and whether or not average earnings could stretch beyond the poverty-line bundle to afford respectability measures progress.

Both subsistence and respectability baskets are computed according to the needs of a single adult male. For household consuming units, the needs of other dependent family members have to be translated into adult equivalents. Allen suggests a family

¹⁸ On the fading but continued importance of agricultural employment see Shaw-Taylor and Wrigley, 'The occupational structure'; and, Wrigley, *Poverty*. On the extent to which agricultural labourers wages lagged behind those of other occupational groups, see Lindert and Williamson, 'English workers living standards'; Feinstein, 'Pessimism perpetuated'; Clark, 'Farm wages'; Allen, 'Engels' pause'.

¹⁹ Allen, 'The great divergence', table 3, p. 421.

²⁰ The figure of 1914 calories cited in *The industrial revolution*, n. 4, p. 35, is presumably a misprint as Floud et al suggest, *The changing body*, n.12, p. 259.

multiple of three, reasoning that: “Since the recommended calorie intake of a woman is less than that of a man, and since, of course, children need even fewer calories, we can say – reasoning rather loosely– that three ‘baskets’ ... were needed to support a family with a father, a mother and some children”.²¹ Thus, his poverty line “is computed for a notional family of a man, a woman, and two children [and] the nonhousing component of their poverty line income is set equal to 3X the basket of goods”.²² Three subsistence baskets would have yielded for family consumption 5823 kcals/day (3 X 1941) and “would have put a four person family at the same level of nutrition as the man”.²³ Is this conversion reasonable?²⁴

²¹ Allen, *The industrial revolution*, p. 38.

²² Allen, ‘The great divergence’, p.425.

²³ Allen, ‘The great divergence’, p.426. I remind readers here that the Ealing gardener had four children.

²⁴ Assuming that the husband and father’s share of resources is ring fenced, to reach the same subsistence level, the women and children in Allen’s families would need in absolute terms 3882 kcals/day. Intra-household resource allocation is discussed further below, p. 10.

III

In the light of modern nutritional studies, Allen's subsistence appears rather meagre, and, on closer inspection, particularly insufficient with respect to women's energy needs with problematic and far-reaching implications. FAO's 1973 reference man was said to need 3,000 calories per day with 2,600 kcals/day allocated to maintenance and 400 kcals/day to moderate activity. The FAO's 1985 new energy requirement indices cover a range of body sizes, patterns of physical activity and needs for compensatory growth and its 2002 updated tables suggest that men aged 18-29 doing moderate physical activity and of mid-size need 2650-3035 kcal/day.²⁵ To justify his much lower subsistence requirement, Allen cites the "Adaptation Hypothesis" put forward by Sukhatme, whereby populations adapt body size to nutritional restriction and remain "small but healthy" at lower levels of caloric intake.²⁶ Such purported adjustment to deprivation has been used to justify reducing the caloric needs of the reference Indian man, but more interestingly here, has been specifically linked to the smaller body size of Indian women and used to justify reduced calorie needs for women and families. Allen cites these arguments to justify the benchmark of 1941 kcals as subsistence for an adult male and 5823 (3X 1941) kcals/day for a family of four persons.

The "Adaptation Hypothesis" has attracted severe criticism.²⁷ For C. Gopalan, President of the Nutrition Foundation of India, it involves acquiescence in "the status

²⁵ FAO, *Human energy requirements*, table 5.4.

²⁶ Allen, 'The great divergence', p. 426. The "Adaption Hypothesis" combines several different ideas and time frames, but its main thrust is to use the hypothetical adaptation of the efficiency of energy utilisation to a lower nutritional intake to challenge any ideal standard of adequate nutrition and replace it with a (lower) critical limit below which adaptation falters and there is evidence of erosion of functional capacity, see Payne, "Assessing". Adaptionists also see children's growth as an instrument of control in the homeostatic process, which moulds the "ultimate size and shape of the adult" to his/her environment, see Seckler, 'Malnutrition', p. 145, and Seckler, 'Small but healthy'.

²⁷ Sukhatme and his colleagues' original formulation of adaption rested heavily on observation of inter-personal and intra-personal variation in intake, which he read as suggesting variation in the efficiency of energy utilisation. Such variation, he argued, undermined "fixed requirements" models, which required replacement by a focus on the lower limit of adaptation. This lower limit, he identified from stochastic variation as two standard deviations below average energy requirements, a statistical cut-off which underpinned his caloric standard, see Sukhatme, 'Measurement'; Sukhatme, *Newer Concepts*, and for an updated account, Srinivasan, 'Undernutrition'. Both methodology and the associated (lower) nutritional requirement came under immediate attack, see the series of related papers in *Economic and Political Weekly*, especially Dandekar, 'On measurement'; and, Mehta, 'nutritional norms'. Osmani, following Sen, developed the probabilistic critique. While an individual might cope with a temporary shortfall, the same argument is difficult to apply when the average intake of a large number of people falls below average requirements. It is unlikely that all members of the group will simultaneously be on the wrong side of the norm in the course of homeostatic variation. "Some

quo in poverty, ill-health, under nutrition and socio-economic deprivation”.²⁸ The way in which the adaptation hypothesis has been used to lower benchmark consumption levels for women, has come in for particular censure, suspected of reinforcing discriminatory practices at the level of the household and adding to female disadvantage.²⁹ Gopalan himself suggests a benchmark of 7940 kcal/day for a notional family of one man and one woman each doing moderate work, a child aged 4-6 and another one aged 1-3.³⁰ Table 1 below presents the caloric requirements based on Sukhatme and Gopalan’s estimates as cited by Allen, and compares them with some alternative recent 2004 FAO figures. Concern here is less with absolute levels than with the estimated relative needs of man versus wife and children. The independent estimates of the nutritional needs of women and children can be compared with those for men and used to evaluate the claim that families could survive, indeed be comfortable, on 3X the man’s subsistence.

Table 1. Daily caloric requirements of families of different sizes and structures

	Sukhatme 1977, 1982a, 1982b	Gopalan 1992	FAO 2004	FAO 2004	FAO 2004	FAO 2004
Man	1891	2800	2650- 2950	2650- 2950	2650- 2950	2650- 2950
Woman		2000	2250- 2500			2250- 2500
Pregnant woman				2532- 2782		
Lactating woman					2925- 3175	
Child aged 7-9						1762

members of the group are likely to have shortfalls that are not homeostatic in nature; such people would be genuinely undernourished”, see *Nutrition*, p. 8 and pp. 121-164; see also Dasgupta, *Inquiry*, pp.437-441. Experts have concluded that independent scientific evidence on ‘pure’ adaption in efficiency unaccompanied by any change in body weight is needed to identify the limits of adaptation. Not only is there no such evidence but no supporting physiological mechanisms have been identified, see Osmani, *Nutrition*, p. 159. Drawing on a huge range of scientific literature, including the magisterial work of J.C. Waterlow, (for example, “Mechanisms”), Dasgupta summarizes “There is more than a little irony in the fact that this thesis, which has had much influence among social scientists is not based on any physiological evidence”, *Inquiry*, p. 441. Thus Sukhatme’s estimate of lower limit nutritional adequacy (1891 kcals/day) has neither logical nor scientific foundation and should be discarded.

²⁸ Gopalan, ‘Undernutrition’, p. 160.

²⁹ Dasgupta and Raj ‘Adapting’; Osmani, ‘On some controversies’; Sridhar, *The Battle*, ch.3.

³⁰ Gopalan, ‘Undernutrition’, p. 28.

Child aged 4-6		1720	1412	1412	1412	1412
Child aged 1-3		1220	1037	1037	1037	1037
Family requirements	5558*	7740 ³¹	7349-7899	7631-8181	8024-8574	9111-9661
Man x 3	5673	8400	7950-8850	7950-8850	7950-8850	7950-8850
Surplus/(deficit)	115	660	601-951	319 -669	(74)-276	(1161)-(811)

Sources: see text.

Notes: * Assumes a wife and two children.

Allen's citation of Sukhatme, does not break down the family requirements by age and gender but as his total of 5558 kcals is less than 3X the man's subsistence, the implication is that a wage which was sufficient to purchase 3X 1891 calories could sustain the man and all members of his family at the same level of nutritional adequacy. Gopalan provides separate estimates for men, women and children. According to his figures, a wife and two small children require 4940 and a man 2800 kcals/day, which makes the family's needs 7740 kcals/day. While this is appreciably more calories than Allen's model offers men, women or their children, the total remains within 3X the man's subsistence (8400 kcals/day).

Columns 3-5 provide estimates based on the latest FAO computations taken from tables which detail requirements by height, weight and activity level (i.e. energy use). For a male population aged 30-59.9, with a mean height of 1.70 m and a mean physical activity level (PAL) of 1.75, the recommended mean energy intake is about 2750 kcal/day to maintain an optimum population BMI of 21, with an individual range of 2650-2950. While the height standard overestimates the stature of the late eighteenth-century working-class population, a PAL of 1.75 relates to 'light activity' and undoubtedly underestimates the demands of manual labour. The working assumption here is a range of 2650-2950 kcals/day, which brackets Gopalan's estimate.³² For a female population aged 30-59.9, with a mean height of 1.70 m and a mean PAL of 1.75, the recommended mean energy intake is about 2350 kcal/day to maintain an optimum population BMI of 21, with an individual range of 2250-2500.³³ Again, the height assumption probably overestimates historic heights but the PAL underestimates activity levels. Note that FAO woman's minimum requirement is well above Gopalan's estimate. The calorie estimates for children are taken from tables

³¹Gopalan's figures are added incorrectly in Allen, 'The great divergence', which gives a total of 7940 kcals.

³² FAO, *Human energy requirements*, table 5.5.

³³ FAO, *Human energy requirements*, table 5.8

relating to energy needs at different ages and levels of habitual physical activity. The children are assumed to be male, which raises energy needs, but to engage only in moderate activity, which reduces them.³⁴ Note that the FAO standards for children are much less generous than those of Gopalan, and mean that the family's total calorie budget stays within 3X the male requirement.

However, in column 4, disaster threatens. The wife/mother falls pregnant (with no option to reduce her activity level). This raises her daily caloric needs by 85 in the first trimester, 285 in the second trimester and 475 in the third trimester, averaging out to about 282 extra kcals/day over the course of the pregnancy.³⁵ The family's needs press against resources. Once the baby is born, assuming the wife breastfeeds, she would need 675 extra kcals/day for the first six months, and, even if she supplements her milk with other infant food, 460 subsequently,³⁶ and a calorie deficit emerges. If this infant survives and the children grow up in lockstep, within a year the family is in grave difficulties (column 6). If the husband's earnings can only afford 3X his requirement, the family faces a severe shortfall for now the woman and children's caloric needs are considerably in excess of double the man's subsistence consumption. Allen's parsimonious benchmark figure of 5823 kcals/day falls well short of these requirements, even if family size froze at three children.

To forestall the obvious rejoinder that modern nutritional requirements are just as inappropriate as the adaptationists' discredited standards, I borrow from a recent authoritative survey of nutrition and human development, which combines the FAO standards with information about the heights and weights of British men in the nineteenth century to estimate the calorific needs of historically representative individuals.³⁷ The results for a 23 year-old man for two different cohorts and three possible work regimes are shown in table 2. Heights and weights from historical samples enable analogous estimates for women also shown in table 2.³⁸ These are not far below men's, and consideration of pregnancy and lactation, which were almost continuous in these high fertility times, would further compress the gender gap.

³⁴ FAO, *Human energy requirements*, table 4.5.

³⁵ FAO, *Human energy requirements*, p.59

³⁶ It could be argued that lactating mothers may have lower PAL requirements than non-pregnant, non-lactating women owing to the frequency of breastfeeding, which involves periods of maternal inactivity. On the other hand, lactating women often carry their infants while moving around, and this additional workload might balance any reduced physical activity associated with feeding itself, see FAO, *Human energy requirements*, p.65.

³⁷ Floud et al, *The changing body*, p. 169.

³⁸ My computations are based on Nicholas and Oxley, 'Living standards'; Horrell et al, 'Measuring misery'.

A comparison of these estimates with the mainly Indian figures cited by Allen reveals the latter's gender bias. While the needs of Gopalan's "Indian man" are close to those estimated for a nineteenth-century British agricultural labourer doing moderate work, the estimates for "Indian woman" are seriously below the reconstructed requirement for the labourer's wife. Other sources suggest that it is not my estimate of women's needs that is excessive. For example, Dasgupta cites a WHO computation of the energy requirements of a "35 year old rural woman in a developing country", whose height (1.6m), BMI (19.5), and routine (3 hours of housework, 4 hours of fieldwork and 2 hours of discretionary activity per day) are similar to a nineteenth-century counterpart, perhaps on a light-work regime. The 2235 kcals/day needed to maintain this woman's (relatively low) BMI is close to my estimates of the needs of her long-dead British sisters in table 2, while 12 per cent above Gopalan's figure for "Indian woman". The uncritical use of some Third World nutrition studies to estimate the needs of historical women spreads the gender bias detected in these modern studies to the past.

Table 2. The caloric requirements of nineteenth-century men and women

	Year of Measurement (age, year of birth)	Height	BMI	Light work	Moderate work	Heavy work
Man	1800.5 (23)	168.83	20.73	2436	2816	3377
	1850 (23)	172.87	20.73	2503	2894	3470
Woman (rural)	1817-40 (23, n/a)	156.6	n/a	2200**	2550**	2750**
Woman (urban)	1817-40 (23, n/a)	154.3	n/a	2200**	2550**	2750**
Woman	1866-78 (23, 1800-09)	152.0*	24.09*	2250	2650	2850

Sources: Floud, et al, *The Changing Body*; p.169; Nicholas and Oxley, 'Living Standards', p. 733; Horrell et al, 'Measuring misery', p.106-7.

Notes: * estimated from regressions in Horrell et al, "Measuring misery", p.106-7; ** Assuming a BMI of 21 and light work = PAL of 1.75, moderate work = PAL of 2.05 and heavy work = PAL of 2.20.

To drive these points home, table 3 shows the calorie requirements, according to FAO standards of a family that is now familiar: the family of the Ealing gardener.³⁹

Table 3. *The calorie requirements of the family of the Ealing Gardener*

	FAO 2002
	Ealing gardener
Man	2650-2950
Woman	2250-2500
Boy aged 8	1762
Boy aged 6	1525
Girl aged 4	1200
Girl aged 1½	850
Family requirements	10237-10787
Man x 3	7950- 8850
Surplus/(deficit)	(2287)- (1937)

Source: see text.

While these absolute caloric levels might be disputed, the extent to which the calorie needs of this (real) family exceed those of the husband/father multiplied by three is so large that even major adjustments could not bridge the calorie gap. The relative needs of the woman and children are too great. Once attention is on historically realistic individuals located in households of representative sizes and structures, the assumption that women and their children could be maintained at the male standard on double the cost of a man's consumption bundle appears to be hopelessly wide of the mark.

These figures imply that at the start of the nineteenth century a significant proportion of family members may not have had access to sufficient calories to undertake arduous work on a regular basis or participate in any discretionary activities or maintain a healthy BMI.⁴⁰ Guaranteeing the share of male breadwinners, may have been a rational response, enabling the husband and father to remain in work and so contribute to the well-being of the family as a whole. However, this meant that any

³⁹ FAO, *Human energy requirements*, tables 4.5, 4.6, 5.5 and 5.8.

⁴⁰ See also, Floud et al, *The changing body*, p. 168.

shortfall imposed exclusively on the share of women and children and so contributed to their undernutrition with adverse effects on the health of the next generation.⁴¹

⁴¹ Harris, 'Gender, health and welfare'; Humphries, 'Bread'; McNay et al, 'Excess female mortality'.

IV

The faulty foundations of the HWE are not limited to the problematic conversion of women and children into adult equivalents for the purposes of assessing nutritional requirements. They are also flawed in their ideas about family size and structure. In fact, the Ealing gardener was fortunate in having, by the standards of the time, a small family. Others were not so fortunate. One source of the pressures on Bill H____’s embattled family was its “wonderful large size”! Such large families were common, indeed more common than the smallish one supported by the Ealing gardener. Table 4 reproduces some rare evidence on children born into early nineteenth century families based on the retrospective fertility questions from the 1911 census. The evidence suggests that in the mid-nineteenth century, it was common for seven or eight children to be born into working-class families with some variation between occupational groups. Earlier in the century, when marriage age was lower, even more children would have been born.

Table 4. Children born and children surviving, by occupational group

Approximate marriage dates	Agricultural labourers	Miners	Textile workers			
	Children born	Children surviving	Children born	Children surviving	Children born	Children surviving
-1861	7.94	5.68	8.23	5.00	7.36	4.73
1861-1871	7.28	5.55	8.27	5.50	6.71	4.51
1871-1881	6.70	5.36	7.76	5.44	5.84	4.18

Source: Stevenson, “The fertility’, pp. 401-32.

George Holyoake’s experience was common; he recalled his mother “had many children; she reared eleven”.⁴² George Lansbury understood the reasons for such large families; his parents married young and “their family increased and multiplied at a rapid rate. There was no talk of birth control clinics when I was born, so my mother’s family of nine came into the world at quite regular intervals of between eighteen or twenty months”.⁴³ Before these individual remembrances are dismissed as outlandish outliers, other mainstream evidence should be considered. Table 5 shows completed family size for women surviving to age 50, computed from the family reconstitution

⁴² Holyoake, *Sixty years*, p. 15.

⁴³ Lansbury, *My life*, p. 19.

that underpinned Wrigley et al's classic demographic history.⁴⁴ It suggests that on average women might bear five or six surviving children. Moreover, for families with children, the size of the sibset was bigger still. The average number of children ever born by a group of women differs from the average sibling group of children of those women. Women contribute equally to the former while women with large families contribute disproportionately to the latter. For example, if half of a group of women have four children and half have none, the average family size for a woman would be two but for a child it would be twice as large, that is four. Demographers have demonstrated the simple and exact relation that exists between average number of children ever born to a cohort of women and the average sibset of children of those women.⁴⁵ The 'Preston correction' is defined in the heading of column 4, table 5, and applied to the fertility data to compute sibling group sizes for the eighteenth and nineteenth-centuries. As can be seen, averages based on the best demographic data available demonstrate that sibsets typically consisted of seven or eight children.

Table 5. Marital fertility and average size of sibling group

Years	Completed family size, X_m	Variance of X_m , $\sigma^2_{X_m}$	Computed average size of sibling group, $C = X_m + \sigma^2_{X_m}/X_m$
1700-1750	4.701	10.0175	6.832
1750-1800	5.463	11.0120	7.479
1800-1837	5.536	11.2599	7.570

Source: Completed family size calculated from the data that generated table 7.17, p.403, in Wrigley et al, *English Population History* and kindly provided by J.E. Oeppen along with the estimates of $\sigma^2_{X_m}$ needed to compute the average size of sibling group.

The averages shown in table 5 are based on data for the population as a whole. For working-class families and especially those headed by men in occupational groups with high fertility such as agricultural labourers, numbers of children would have been higher still. Bill H____'s family size is looking less outlandish.

Of course, to counterpoise large families, there were others that had no or few children either because of their stage in the family life cycle or because of infertility. Such families, if their male heads earned at the level of London artisans, were

⁴⁴ Wrigley, et al, *English population history*, p.403.

⁴⁵ Preston, 'Family sizes'.

comfortably off. Single men and young couples, for example, could enjoy a high standard of living; but for the latter at least, once babies began to arrive, resources became stretched. At the end of the family lifecycle too, households might be relatively empty, but it was a rare working person who either maintained his/her earnings capacity or saved enough for a comfortable old age. Children were not distributed equally across working-class households, indeed this was an important source of intra-class inequality. However, most families in these high fertility times experienced years of burdensome dependency and even as a cross-section average, the HWE assumption of two children appears an underestimate.

Recognising the need for more realistic assumptions about family size, in a recent related paper on the standard of living of agricultural labourers' families, Allen, writing with Jacob Weisdorf, acknowledged that for this group of workers a family poverty line computed from tripling the costs of a man's subsistence basket was probably insufficient.⁴⁶ To capture increasing pressures from family size on living standards, Allen and Weisdorf offer a flat rate multiple that shifts from 3 to 3.25 or variable multiples based on the dependency ratio or $2 +$ the net reproduction rate.⁴⁷ The variable multiples do suggest demographic pressures on the living standards of agricultural labourers in the period, strains which the authors believe might have led to an increased labour supply from the women and children in labourers' families. In such families increased industriousness was a defensive response to pressure on subsistence standards rather than an active strategy to secure more disposable income. While these findings and their interpretation move in the right direction, the strategies to compute intra-family dependency remain inadequate. The former continues to distribute children (and the elderly) equally across families, while the latter fails to recognise another unpleasant demographic fact of the times: many more children were born and partially raised than survived to figure in the NRR. Referring back to table 4, Stevenson's recompilation of the unique data from the 1911 Census compares children born with children surviving to show that on average around two children per family perished before adulthood.⁴⁸ Families suffered non-trivial economic as well as emotional costs because of investing in babies, infants, children and adolescents who died before adulthood. Death rates in infancy and childhood did decline in the eighteenth century but slowly and inconsistently and while deaths in the first months of life fell this just meant that there were more confinements and more babies surviving to die in later childhood.⁴⁹ Moreover, there is good evidence to suggest that infant and childhood mortality deteriorated in the first half of the nineteenth century, meaning that families faced the costs of bearing and at least partially raising children only to have them die before adulthood with greater frequency.⁵⁰ By these times, with

⁴⁶ Allen and Weisdorf, 'Was there an industrious revolution?'

⁴⁷ The dependency ratio is taken from Wrigley and Schofield, *Population history*, p. 443.

⁴⁸ See also, Anderson, 'Social implications', p.38.

⁴⁹ Wrigley, *Energy*, p.152.

⁵⁰ Wrigley, et al, *English population history*, pp.256-261.

luck, families lost two such children but many lost more. As Bill H_____ laconically put it, his very large sibset “died down” to the more manageable size of six.⁵¹

Moreover the misjudgement of the families of the past does not stop at the attenuation of family size and so misjudgement of the adequacy of men’s earnings to support dependents. It extends to the ahistorical assumption that all families had a male head on whom to depend. Even a cursory inspection of Allen’s chosen contemporary commentary, Eden’s *State of the Poor*, would have revealed overwhelming evidence to the contrary. Eden’s survey covers a number of households headed by widows, a number headed by absent soldiers and sailors (remember this is the height of the French wars), and several wives whose husbands had simply “run away”. Households of this kind occur with great regularity in surveys of working class conditions and listings of households by type, are frequent on lists of outdoor relief and charitable subsidies, and evident in workhouse populations. While the prevalence of female-headed households and women struggling to raise their children alone is etched into the historical record, it is not the only sign that not all families matched up to the template assumed in the HWE model. There were other kinds of incomplete, broken or disintegrating families. Mothers too died or (very rarely) abandoned their families, leaving fathers to soldier on alone. Both lone mothers and (*a fortiori*) lone fathers tried to patch up crumbling families through remarriage, though this often raised the burden of dependency. For some unlucky children both parents died or disappeared leaving them to the care of other kin, the poor law or charities. There were even households headed by children who sought to look after siblings and there were children who fell through all the safety nets of kin, parish and charitable trusts to live on the streets and under the hedges of eighteenth and nineteenth-century Britain.

It is possible, although not easy, to estimate the frequency with which children grew up without parental support. The numbers turn out to be non-trivial. The evidence is piecemeal but on the basis of listings of households by size and structure for a number of early modern communities, Laslett calculated that 20.7 per cent of children resident in families had lost either their father or their mother, with many more apparently fatherless than motherless.⁵² Based on data for Bristol in 1694, which added a large urban community to the predominantly rural parishes that Laslett had investigated, Holman found that 24 per cent of resident children lived in single-parent households, with again many more dependent on lone mothers than on lone fathers.⁵³ Trends in the cross-sectional averages suggest that orphanage increased over time. However, these sources record not the proportion of children orphaned but those living in lone-parent families. Many families did not survive the death of a parent but

⁵¹ Bill H_____, ‘Autobiography of a navy’, p. 140.

⁵² Laslett, ‘Parental deprivation’; see also Anderson, ‘Social implications’.

⁵³ Holman, ‘Orphans’.

were broken up and the children scattered. Moreover, the doubly unfortunate children who lost both parents were usually absorbed into other households or institutionalized, and cannot be identified in listings or household surveys. Moreover, orphanage at any one point in time underestimates the proportion of children bereft of one or other parent during childhood, which Laslett projected from the cross-sections at about one third of resident children. Another study, based on the unusually detailed death registers for Shifnal in Shropshire in the first quarter of the eighteenth century, also offers a longitudinal perspective and suggests that 40 per cent of children who survived to age 16 had lost a parent, with marked differences by social class.⁵⁴

Evidence that is even more valuable is available in the form of simulations of orphanage using CAMSIM and based on demographic parameters from Wrigley, Davies, Oeppen and Schofield.⁵⁵ The results of simulating 10k male egos and their biological parents and step-parents suggested that for 1750-1799 between 14-19 per cent of children lost their mother before their 14th birthday, between 16-18 per cent lost their father and between 27-33 per cent lost either their mother or their father. Improvements in adult mortality meant that for the period 1800-1837, the proportions were 11-16 per cent, 14-15 per cent and 23-28 per cent.⁵⁶

Intriguingly, my estimate of childhood bereavement based on a sample of working-men's autobiographies tracks population demographics, but with one striking difference.⁵⁷ The autobiographical evidence recorded expected levels of maternal mortality but a surprisingly high death rate for fathers. This is no statistical aberration but reveals an important characteristic of the families of the time: many were without a yet-living husband/father. The autobiographers sometimes made it hard to distinguish fathers who had died from those who had become detached from their families or never married their mothers. This distinction is almost impossible if writers deliberately covered up desertion or bastardy by reporting fathers as dead. It must have been tempting to evade shame with a white lie about paternal demise. Indeed several autobiographers were exposed in such subterfuge.⁵⁸ Thus, the excess paternal mortality recorded in the autobiographies probably in part reflects an element of *de facto* fatherlessness. Moreover, to the suspiciously-inflated total of dead fathers must be added the non-trivial number openly, if painfully, reported as absent though not presumed dead. A sad fact revealed by the autobiographies, and supported by other historical sources, was that not all fathers were reliable. Men abandoned women and children before marriage; witness the high and rising illegitimacy rate.

⁵⁴ Watts, 'Demographic facts', p. 43.

⁵⁵ Smith and Oeppen, 'Estimating Numbers'; Wrigley, et al, *English population history*. See also, Anderson, 'The social implications', p. 49.

⁵⁶ For more detail on these figures see, Humphries, *Childhood*, p.65.

⁵⁷ Humphries, *Childhood*, chapter 3.

⁵⁸ See Humphries, *Childhood*, p. 66.

They volunteered to serve in the forces, or were recruited or press-ganged. They emigrated, promising (probably in good faith) to send for families, but became disconnected. They were imprisoned, transported, even executed for crimes they did or did not commit. Even if fathers remained with their families, they were not all competent breadwinners. Some were hopelessly alcoholic. Others became ill or incapacitated. Yet others went off looking for work or higher wages and somehow lost touch with the women and children left behind. According to my estimates, depending on what proportion of the excess paternal mortality recorded in the autobiographies is taken as indicating alienation and abandonment somewhere between 8 and 18 per cent of boys grew up separated from yet-living fathers.⁵⁹

This finding is consistent with other historians' depiction of the eighteenth century as a period of considerable marital instability, in turn associated with economic, social and political conditions.⁶⁰ While rates of separation and desertion are very difficult to pin down some historians have suggested rough orders of magnitude. Based on the demographic reconstitution of Colyton, Pam Sharpe concluded that 10 per cent of all marriages pledged between 1725 and 1756 ended in separation.⁶¹ Using settlement examinations, Keith Snell held that the rate of family break-up in rural England was relatively stable over nearly two centuries at around 5-6 per cent,⁶² while David Kent argued for a rate roughly three times larger and much more volatile for his large London constituency.⁶³ Joanne Bailey's recent multi-sourced study of matrimonial conflict, while unable to quantify rates of family breakdown, nonetheless strongly suggests that desertions increased from the seventeenth century, consistent with contemporary perceptions that runaway husbands were becoming more common.⁶⁴

Male-breadwinner households' grip on the HWE was only as reliable as the men who headed them and these men's ability and commitment to provide support could prove frail indeed.⁶⁵ The presence of a significant group of families whose fathers while yet living were not present, alongside the perhaps 18 per cent whose fathers had died, testifies to the turbulence of the times with war, empire building and labour mobility straining men's links to wives and children. It warns against assuming that

⁵⁹ Humphries, *Childhood*, pp. 63-76, 80-83.

⁶⁰ Emmison, *The relief of the poor*; Stone, *The family*; Outhwaite, 'Problems'; Snell, *Annals*; Kent, 'Gone for a soldier'; Sharpe, 'Literally spinsters'; Sharpe, 'Marital separation'; Humphries, 'Female-headed households'; Bailey, *Unquiet lives*.

⁶¹ Sharpe, 'Marital separation'.

⁶² Snell, *Annals*, p. 361.

⁶³ Kent, 'Gone for a soldier', p. 30.

⁶⁴ Bailey, *Unquiet lives*, p. 174ff.

⁶⁵ For further discussion of 'breadwinner frailty', see Humphries, *Childhood*, p. 172, pp. 367-8.

all families were supported by any male wage let alone one able to purchase 3X the male subsistence.

V

This alternative account of the needs, structure and functioning of the working-class family challenges the HWE paradigm. It has reminded readers that the lifecycle of the standard family meant at least one stage when the man's earnings even if delivered up in full and sufficient to buy 3X his own subsistence could not cover the caloric needs of dependent women and children. For many families this stage was prolonged by long tails of dependent children or the father's incapacity. The implications are stark and important. One response has already been suggested: the ring-fencing of the father's share of household resources to ensure his capacity to work albeit at the expense of other family members. Much direct and indirect evidence suggests that this response was widespread with important knock-on implications for the health and wellbeing of women and children and thereby of future generations. However, there was another common option: the employment of women and children. Such 'added worker' strategies underpinned the 'industriousness' among the families of agricultural labourers to which Allen and Weisdorf allude.⁶⁶ Remember the poverty of Bill H____'s family was exacerbated because the boys were unable to find work and so assist their father in his breadwinning. Of course, for those many families that had no male head let alone a competent breadwinner, there was only one choice. The availability of needy and pliable women and children, and the public interest in putting them to work rather than supporting them on the rates, provided another motive for invention and innovation, as classic accounts of the industrial revolution emphasized.⁶⁷ Mechanization promised savings not only by replacing expensive male labour with capital but also by replacing it with cheap female and child labour. Which motive was uppermost?

The motivation of inventors and the effects of their inventions are not transparent. Christine MacLeod's pioneering investigation of patent records revealed the "stresses and opportunities" incentivising inventors.⁶⁸ These were surprising, and are even more so in view of the ascendancy of the HWE paradigm. Early eighteenth-century inventors rarely claimed that their innovations saved labour, inventors probably judging it unwise to publicise any adverse effects on local employment.⁶⁹ Interestingly, they were more likely to promise employment creation, particularly of jobs for women and children, who by implication would otherwise be a burden on the rates. However, over time it became more acceptable to claim that an invention replaced labour, and by the 1790s patentees had lost all inhibition, with inventors in textiles, metal and leather trades, agriculture, ropemaking, docking and brewing all

⁶⁶ Allen and Weisdorf, 'Was there an industrious revolution'.

⁶⁷ Deane, *First industrial revolution*; see also Berg, *Age of manufactures*.

⁶⁸ MacLeod, *Inventing*, p.158.

⁶⁹ Of the patents which specified a motivation, only 4.2 per cent aimed to save labour, MacLeod, *Inventing*, p.159; see also Mokyr, *Lever of Riches*, p. 165

claiming such an advantage. Even then, savings were not of all labour but mainly the labour of skilled adults. Inventions were often advertised as reducing the need for strength or skill and so facilitating the substitution of unskilled women and children for adult trained operatives. The calculations by John Wyatt in defence of his (and Lewis Paul's) spinning engine are instructive, not least for the alertness shown to the interest of the poor law authorities in creating work for women and children. Wyatt claimed that a clothier who employed a hundred workers might turn off thirty "of the best of them" but take in ten children or disabled persons and thereby be 35 per cent richer, while the parish would save £5 in forgone poor relief.⁷⁰ Since such substitution was at the heart of worker resistance to new technology, it required a certain boldness to make such claims, and probably suggests that more inventions than announced were directed to this end.⁷¹ Further scrutiny of the patent record and contemporary accounts of innovation reveal another motive: the search for greater control over the labour process, the quality of products and the regularity and intensity of work. This too went hand in hand with increasing the employment of women and children. Manufacturers and inventors saw the technical and economic advantages in using a new workforce in such a way as to bypass artisan practices and controls and so sap resistance to change.⁷² Although high wages, and even absolute labour shortages with men away at war, meant economic "stresses" that nudged invention towards saving labour, at the same time the supply of cheap and (relatively) docile female and child labour provided "opportunities" which also incentivized inventors and manufacturers; as the pioneering historian of mechanization has put it: "...machines and processes were invented with this female and child labour in mind".⁷³

It is not surprising that inventors should be alive to the opportunities implicit in female and child labour for many of them were rooted not in the coalfields or metallurgical industries but in the rural proto-industrialization that had soaked up under-employed family labour. In these industries, where innovation was often in the nature of the products as much as the equipment, the availability of female and child labour moulded the evolution of technology and there are many examples of machinery specifically designed to be worked by women or by one adult with child or family assistants.⁷⁴

⁷⁰ And "the Kingdom" would gain "thirty able people", (assuming they could be redeployed of course), quoted in MacLeod, *Inventing*, p. 164.

⁷¹ Dean Tucker contrasts the reception of machinery in mining where it helped reduce physical exertion and in textiles where it helped the substitution of unskilled women and children to show labour's recognition of different interests, see MacLeod, *Inventing*, p. 163-4.

⁷² Berg, *Age of manufactures*; Berg, 'Workers'; Randall, *Before the Luddites*.

⁷³ Berg, *Age of manufactures*, p. 147.

⁷⁴ Berg, *Age of manufactures*, ch.8.

Moreover, while important, mechanisation was just one element in changes in the organization of work, which characterised the first industrial revolution. Eighteenth-century economic growth rested on a growing division of labour, the rise of workshop production, and the eventual emergence of the factory system. These changes facilitated mechanization but were themselves facilitated by the availability of female and child labour in rural and provincial areas of Britain. An industrial revolution, which focuses on macro inventions, (many of which did not come on stream until the nineteenth century), and ignores the vitality of this earlier phase of Smithian growth is historiographically retrograde.⁷⁵ The rather unsavoury Richard Arkwright is often airbrushed out of group portraits of great inventors but he did pioneer the application of water power to the jenny and so the factory phase of textile production. When he made this crucial innovation, he located his mill at Cromford in Derbyshire explicitly to exploit the labour of the children of local lead miners, whom he expected to be able to employ, as the mines were on the verge of exhaustion and the families impoverished.⁷⁶ In fact, Arkwright's machinations miscarried. The miners resisted sending their children to work at his mill and he was forced to recruit labour elsewhere; but his target remained women and children and when the mill opened he employed 200, the youngest of whom was seven.

As a child, Bill H_____ was excluded from Allen's HWE as a result of his father's irregular and low paid employment and his mother's fecundity. As an adult, he remained an outsider because he lacked skills and was inclined to hard living. Bill's restless lifestyle got him into trouble and he even spent time in gaol, where, in fact, he obtained "most of [his] scholarship".⁷⁷ Although he never confessed to fathering any children, his several amorous encounters and peripatetic lifestyle suggest that he might well have been one of the many "deadbeat dads" who went missing in these turbulent times. Like many of his peers, Bill started work early and laboured hard for most of his life. Such workers dug the canals and drove the railways that linked workshops, factories, markets and ports. Thus, the early industrial economy combined two labour markets each linked into a specific kind of family structure: the first focussed on skilled adult males in prime locations whose costliness, while enabling the support of a wife and children, simultaneously encouraged the substitution emphasized in the new conventional wisdom; but the second dealt in the labour of unskilled (and sometimes broken down) men, and an increasing number of needy women and children, who had no male breadwinner on whom to rely. The

⁷⁵ The HWE paradigm ignores the extensive literature on the role of women workers in different industries during industrialization as well as a number of recent publications, which have documented the extensive and intensive use of child workers. Both types of workers have been shown important not only in facilitating the growth of new industries and new organizational forms but also in sustaining the persistence of traditional industries and older forms of industrial organization. See, Kirby, *Child labour*; Honeyman, *Child workers*; Levene, 'Parish apprenticeship'; Humphries, *Childhood*.

⁷⁶ http://en.wikipedia.org/wiki/Cromford_Mill.

⁷⁷ Bill H_____, 'Autobiography of a navvy', p. 147.

second type of labour too prompted invention, innovation and (perhaps more importantly) work reorganization and it too contributed to the industrial revolution.

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