Losing the Thread: A Response to Robert Allen[†]

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Abstract

In our earlier paper we used archival and printed primary sources to construct the first long-run wage series for hand spinning in early modern Britain. Our evidence challenged Robert Allen's claim that spinners were part of the 'High Wage Economy', which he sees as motivating invention, innovation, and mechanisation in the spinning section of the textile industry. We respond to Allen's subsequent criticism of our argument, sources and methods, and his presentation of alternative evidence. Allen contends that we have understated both the earnings and associated productivity of hand spinners by focussing on part-time and low-quality workers. His rejoinder rests on an ahistorical account of spinners' work and similarly weak evidence on wages as did his initial claims. Our augmented version of the spinners' wages dataset confirms our original findings. Spinners' wages were low even compared with other women workers, and neither wages nor the piece rates that determined unit labour costs followed a trajectory that could explain the invention and spread of the spinning jenny.

JEL Codes: J24, J31, J42, J46, N13, N33, N63, O14, O31

Keywords: hand spinning, women's wages, Industrial Revolution, textiles, Great Divergence, induced innovation, High Wage Economy

[†] We are grateful to Peter Solar, Judy Stephenson, and John Styles for comments and suggestions, and we thank the Economic History Society and the Pasold Research Fund for supporting our data collection. We would also like to thank the three anonymous referees for their comments.
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In our earlier paper we used archival and printed primary sources to construct the first long-run series of wages and empirical estimates of productivity for hand spinning in early modern Britain. This evidence challenged Robert Allen's claim that spinners were part of the 'High Wage Economy' and that their high wages motivated invention, innovation, and mechanisation in the textile industry, specifically the development and diffusion of the spinning jenny. His response criticises our argument, sources and methods, while reiterating his own position. Whereas Allen has attenuated his original data without explanation and added only two observations of the same hearsay kind used earlier, we have continued to investigate spinners' wages and productivity, adding more than 1500 new observations to our dataset. These reinforce our view of spinning as a low-productivity, low-earning occupation. Professor Allen, not us, is spinning his wheels.

I

Robert Allen includes estimates of hand spinners' daily wages on his website, which draws together comparative data on wages and living costs. He used these estimates and assumptions about spinners' working time to parametrize his model of the returns to a hand spinner's investment in a jenny in the 1780s.[1] More boldly, he graphed the spinners' day wage series to show that its peak coincided with the cluster of inventions that revolutionised spinning.[2] Here, Allen asserts that 'a sturdy hardworking young spinner' could spin about a lb of yarn per day, a level of production that would have earned his stylized spinner 8d (implying a piece rate of 8d per lb). In his 2015 paper, he went further, claiming that daily earnings rose to 12d in 1770–1774, a dramatic pinnacle strategically coincident with the spinning inventions. This high point has now been summarily dropped, significantly changing the earnings trajectory in his Figure 1.[3]

There are several problems with Allen's stylized spinner. First, we have no information on how many spinners would have qualified as 'sturdy' or 'hardworking'.

[1] Robert C. Allen, "The Industrial Revolution in Miniature: The Spinning Jenny in Britain, France, and India," *The Journal of Economic History* 69, no. 4 (2009).

[2] "The High Wage Economy and the Industrial Revolution: A Restatement," *The Economic History Review* 68, no. 1 (2015).

[3] 'The figure of 12 pence per day for 1760–4 has been excluded from the calculations', notes to Figure 1, "Spinning Their Wheels: A Reply to Jane Humphries and Benjamin Schneider," *Oxford Economic and Social History Working Papers* No. 166 (2018): 10. Allen's website records this level of wage for 1770–4.

Second, it is unclear why scholars should be more interested in their earnings than the *actual* earnings of *real* spinners which would have motivated innovation, and which we report here and earlier. Third, as discussed later, the evidence does not show spinners producing a lb of yarn per day except in unusual circumstances. Allen contends that this was because they did not work full time; indeed, he claims that he never assumed spinners produced a lb a day or earned the day wages reported on his website. These, he says, are full-time equivalents, whereas most spinners spun part-time, assumed at 40 per cent of 250 total working days (100 days per year), a supposition built into his estimates of the returns to spinning machinery and spinners' contributions to family incomes.[4] Thus, Allen claims to use 'full-time data' adjusted for part-time work to derive actual earnings (and productivity), and accuses us of being vague about working time. The implication is that our estimates are low because they are not for full days of work. We agree that some hand spinners did work part-time, but not all, and not for the reasons that Allen implies, or in the way that he supposes.

Allen contends that spinners worked part-time consistently, choosing daily to put aside their spinning wheels and forgo earnings. His stylized spinner displayed a preference for leisure or had very modest consumption aspirations, as he makes clear in his defence of the assumption of fixed output in his computation of the return to investment in a jenny.[5] Backward bending supply curves are inconsistent with the voluminous contemporary evidence suggesting that spinning was a valued source of income for impoverished and

[4] To justify these assumptions Allen points to Eden's claim that married women could only spin 2.5 lbs per week compared to 6 lbs for unmarried women, but archival sources show differences of no more than 10% in productivity by marital status (see Bodleian Library MS North d 51). Allen also directs readers to A. S. Bhalla, "Investment Allocation and Technological Choice-a Case of Cotton Spinning Techniques," *The Economic Journal* 74, no. 295 (1964). Bhalla cites a report that states spinners in mid-20th century India worked for 'no more than' four to six hours per day. Allen does not explain why evidence from 20th century India is an appropriate guide for working time in 17th and 18th century Britain. Robert C. Allen, *The British Industrial Revolution in Global Perspective* (Cambridge: Cambridge University Press, 2009), 214. See also John Styles, "Robert Allen's Spinning Jenny Is Still Broken," http://spinning-wheel.org/2019/05/robert-allens-spinning-jenny-is-still-broken/.

[5] Gragnolati, Moschella and Pugliese criticised Allen's assumption that after purchasing a jenny and increasing her productivity, a spinner would produce the same amount and work fewer hours, see Ugo Gragnolati, Daniele Moschella, and Emanuele Pugliese, "The Spinning Jenny and the Industrial Revolution: A Reappraisal," *The Journal of Economic History* 71, no. 2 (2011). In his reply Allen argued that it was unlikely that after mastering the jenny a spinner would maintain the same number of days work per year, as spinners likely had '…a target level of consumption and adjusted their work year to achieve it', Robert C. Allen, "The Spinning Jenny: A Fresh Look," ibid.: 461.

otherwise underemployed women and children.[6] Women spinning for their own use or servants engaged in a menu of tasks undoubtedly spun part-time, fitting the activity around cleaning, washing, sewing and brewing.[7] Others were professional spinners whose livelihoods were earned at the wheel.[8] Such spinners worked as near to full-time as possible, particularly those in urban areas or regions where protoindustry was well established.[9] Even so, spinners were at the mercy of putters out for work and the yarn factors themselves were constrained by fibre supplies and cyclical and seasonal changes in demand.[10] Instead of working part-time throughout the year, many spinners appear to have spun full time when fibre was available and other work scarce. Spinning was patched into an economy of makeshifts that together provided an income.[11] This pattern of work means that, *contra* Allen, many of the recorded wages and outputs we cite relate to full days or weeks of work.

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[6] Comments from the 16th to 18th centuries attesting to the poverty of spinners include Letter from John Saunders to the Privy Council, Cecil Papers, CP 197/86. Alfred Powell Wadsworth and Julia de Lacy Mann, *The Cotton Trade and Industrial Lancashire, 1600–1780* (Manchester: Manchester University Press, 1931), 90. Adam Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations* (New York: Random House, 1974), Book IV, Chapter 8, 608. The lack of employment for the rural poor produced by mechanization is discussed in C. Vancouver, *General View of the Agriculture of Devon* (1808), 464, T. Rudge, *General View of the Agriculture of Gloucester* (1813), 346–347, and the Report of the Poor Law Commissioners (1834). Allen agrees that spinners were generally poor, Allen, "Spinning Their Wheels: A Reply to Jane Humphries and Benjamin Schneider," 1.

[7] Like Phoebe Beatson, the young female servant employed by clergyman John Murgatroyd, see Carolyn Steedman, *Master and Servant: Love and Labour in the English Industrial Age* (Cambridge: Cambridge University Press, 2007).

[8] Such as Joanne Pittman, see Charmian Mansell, "Female Service and the Village Community in South-West England 1550–1650," in *Servants in Rural Europe: 1400–1900*, ed. Jane Whittle (Woodbridge: The Boydell Press, 2017), 88–89, 91.

[9] Richard Latham's daughters were pre-occupied with spinning and he was often obliged to employ non-family labour to assist on the smallholding, see Richard Latham and Lorna Weatherill, *The Account Book of Richard Latham, 1724–1767* (Oxford: Oxford University Press, 1990).

[10] Jane Humphries and Benjamin Schneider, "Spinning the Industrial Revolution," *The Economic History Review* 72, no. 1 (2019): 152. Benjamin Schneider, "Creative Destruction in the British Industrial Revolution: Hand Spinning to Mechanisation, C. 1700–1860" (M.Sc. Thesis, University of Oxford, 2015). The blanket manufacturers of Witney, cited by Allen as a well-functioning putting out system, valued their export markets because, as ships sailed in the spring, these complemented the summer work geared to domestic demand and reduced seasonal variation, see Simon Townley, *The Victoria History of the County of Oxford, Volume Xiv: Witney and Its Townships* (London: Oxford University Press, 2004), 79–80.

[11] Olwen H. Hufton, *The Poor of Eighteenth-Century France 1750–1789* (Oxford: Clarendon Press, 1978). Jane Humphries, *Childhood and Child Labour in the British Industrial Revolution* (Cambridge: Cambridge University Press, 2010), 102–18.

Moreover, if the cost of hand spinning was the motive to mechanize, the time allocation of spinners is of second-order importance. It would affect the range of putting out operations and so transport costs and the timeliness of turnaround, but since masters paid piece rates, they would not care whether spinners took 1 or 2 days to produce each lb of yarn since they paid the same price for the work.[12] The most salient cost for induced innovation would have been the piece rate, trends in which we analyse in Section V. The use of piece rates would have incentivized hand spinners to diligence when work was available, a point that Allen makes for construction workers.[13] Further, it is unclear how Allen can be certain that the wage figures he provides are for full-time work. As noted below, he now rejects his original sources, but his 'new' sources are opaque about the origin of their information and do not state working hours.

In short, the assumption of a backward-bending supply curve seems at odds with the pressures on clothiers to source yarn, the absence of alternative work in rural areas, the poverty of many spinners, and the incentive effects of piece rates. Our view of how spinners worked, based on contemporary descriptive sources, supports our interpretation of many recorded wages as day rates. Moreover, even if our observed wage levels are for part-time workers, the data do not show a trend that would have induced mechanization in the 1760s and 1770s.

II

In contrast with Allen's paradoxical proposition of high and rising unit labour costs but low actual earnings, we argued that spinning employment could have expanded without pressure on wages. Monopsony was one possibility. Yarn masters had market power, as illustrated by Jane Fiske's study of the Oakes family, prominent Suffolk clothiers, with extensive spinning networks.[14] Fiske shows that masters collectively decided spinning piece

[12] Here the assumption is that masters are the inventors and innovators. In computing the returns to investment in a jenny, Allen assumes it is the spinner herself who invests, hence increased profit is measured by the value of the time she saves producing the same output, as in Allen, "The Industrial Revolution in Miniature" or the value of the increased output when she works the same time on the more productive machine, as in Allen, "The Spinning Jenny".
[13] Allen, "Spinning Their Wheels: A Reply to Jane Humphries and Benjamin Schneider," 10.
[14] Humphries and Schneider, "Spinning the Industrial Revolution," 150–52.

rates at an annual meeting at the local wool hall 'so that the manufacturers' claim that free competition kept wages up was less than the truth'.[15]

Allen counters the monopsony argument with an account of a competitive labour market in the wool industry around Witney.[16] The original source appears to be Robert Plot, whose account has been widely reproduced and underpins the description in the Victoria County History for Witney and its townships on which Allen depends.[17] While this secondary source describes a putting-out system providing widespread local employment, the author emphasizes that numbers were often exaggerated and that the industry experienced busts as well as booms.[18] Allen claims that in the eighteenth century about 7000 packs of wool were processed a year in Witney which, assuming as he does that each woman spun 100 lbs a year (.4 lbs per day for 250 days), would have provided employment for 16,000 spinners. We could not locate the source of the estimate of fibre supply, but Townley, Allen's main reference, disputes this figure. He says that while some 10,000 people, including carders and spinners in surrounding villages, were claimed to be dependent on the industry this figure was inflated. The actual number was closer to 5000 even 'allowing for part-time and seasonal work'. Local labour does not seem to have been exhausted. The Royal Charter of the Witney Blanket Weavers Company, established in 1711 to control the numerous small independent manufacturers operating within a 20-mile radius of the town, reinforced the masters' power. The Company brought masters together to oppose wage increases for journeymen and would have provided the basis for a collective position on spinning piece rates.[19]

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[15] Jane Fiske, ed., "The Oakes Diaries: Business, Politics and the Family in Bury St. Edmunds," *Suffolk Record Society* XXXII (1990).

[16] His reference is to Robert C. Allen, *The Industrial Revolution : A Very Short Introduction* (Oxford: Oxford University Press, 2017), 15–18.

[17] Plot's original description appeared in his *Natural History of Oxfordshire*, in 1677; Cox's 1700 book mentioned textile manufacture at Witney and repeated the account verbatim; in later editions of Defoe's *Tour*, a paragraph which is Plot slightly abridged was inserted; Postlethwayt in his *Dictionary* says that 'Witney['s] […] greatest manufacture is rugs and blankets'. He then follows Cox in repeating Plot's figures of looms, persons employed, etc for 1677! See Alfred Plummer, *The Witney Blanket Industry: The Records of the Witney Blanket Weavers* (London: George Routledge and Sons, 1934).

[18] Townley, *The Victoria History of the County of Oxford, Volume Xiv: Witney and Its Townships*, 80.

[19] Ibid. For further detail on the Company and the blanket makers see Stanley C. Jenkins, *The Blanket Mills of Witney* (2001). Alfred Plummer and Richard E. Early, *The Blanket Makers, 1669–1969: A History of Charles Early & Marriott (Witney) Ltd* (New York: Augustus M. Kelley, 1969). Jane Cavell, *A History of the Blanket Hall, Witney, 1721–2011* (Witney: Early's Archive Trust, 2016).

In short, Allen's certainty on the equal bargaining power of spinners and yarn factors is at odds with the limited evidence including his own case study of Witney. Women in rural areas with few alternative opportunities to earn were often a captive source of labour, a potential explanation for the failure of spinners' earnings to keep up with those of other female workers.[20] As suggested in our original paper, growth of employment on the extensive margin remained a possibility and alongside imported yarn could have augmented supply without the need for wage increases.

III

Allen also contests our productivity estimates. He claims that the workers for whom we have evidence were unrepresentative and that the inclusion of workhouse spinning and philanthropic enterprises produces a downward bias. We disagree: such workers were part of the spinning labour force. There are many references throughout the early modern period to spinning as a source of employment for the poor and recent work, including our earlier paper, has shown that philanthropy and the poor law overlapped with commerce in its organisation. We can add to the illustrations using Allen's own case of Witney, where eighteenth-century masters supplemented yarn supplies by contracts with local poor houses. Arrangements were made with parish officers in Oxford, Stanlake, Bicester, and Burford, and spinning houses in Milton, Woolton, Combe, and Brampton, where Witney blanket masters had wool in 1744 and 1778, may similarly have been workhouses. In common with many prisons, the Witney Bridewell had spinning wheels and cards in 1766.[21]

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[20] Comparison is based on Jane Humphries and Jacob Weisdorf, "The Wages of Women in England, 1260–1850," 75, no. 2 (2015). We believe that it is inappropriate to compare spinners' earnings to those of annual contracted workers, as Allen does, Allen, "Spinning Their Wheels: A Reply to Jane Humphries and Benjamin Schneider," 4. Many gender historians have noted spinners' particularly miserable wages, e.g. Pamela Sharpe, *Adapting to Capitalism: Working Women in the English Economy, 1700–1850* (Basingstoke: Macmillan, 1996). Wage assessments, reflecting market differentials, left spinners adrift from other women's wages, see Michael Frederick Roberts, "Wages and Wage-Earners in England: The Evidence of the Wage Assessments, 1563–1725" (DPhil Thesis, University of Oxford, 1982), 183–84.

[21] Oxford Journal Synopsis, 27 March 1777, 1 December 1781, 1 June 1782, 26th February 1785; ORO Ms Wills Oxon 304/4/26, ibid DAI/8; Bridewell Rec. Witney 3 (April 1778) 15–17; Cited in Townley, *The Victoria History of the County of Oxford, Volume Xiv: Witney and Its Townships*, 84.

Anticipating charges of selection bias, we described the hours of work and supervisory and incentive systems in spinning schools, philanthropic schemes, and workhouse manufacturing. These were far from relaxed regimes, and some provided incentives additional to piece rates for greater production.[22] Nor, in fact, were the personnel so very different from other spinners. Further, our estimates of productivity are backed up by other (independent) scholars working on different sources (e.g. Dolan and Ottoway), corroboration ignored in Allen's reply.[23]

Allen seizes upon the relatively high productivity reported for what he identifies as 'the single commercial enterprise': the Newbury-Kendrick spinning shop. Actually, this enterprise too originated in philanthropy, and our claim that its spinning was of inferior quality wool was based on the judgement of the editor of its business records and confirmed by the miserable piece rates that she cites: 1¾–2d per lb![24] Allen also argues that our estimates of earnings and productivity may be biased by counting each spinner returning yarn as one worker, when she may have been returning the work of several women.[25] This is correct, albeit unavoidable given the sources, but actually biases our productivity and earnings figures *upwards*, towards his claims.

To challenge our archive-based estimates of productivity, Allen presents three 'new' pieces of evidence. The first is from the well-known work by Richard Guest,[26] useful because it relates to cotton spinning by hand which is notoriously difficult to document. However,

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[22] Competitions, prizes, and premiums to drive productivity were common in spinning schools, see E.g. Barnsley Archives EM/985; and Irene F. M. Dean, *Scottish Spinning Schools* (London: University of London Press, 1930), 89–90, 101. The Articles of agreement between the Church Wardens and Overseers of the Poor of Mortlake and Henry Wilkins who managed spinning by the poor specified 12 hour days in summer and 10 hour days in winter, Surrey History Centre, 2397/6/32.

[23] Alice Dolan, "The Fabric of Life: Time and Textiles in an Eighteenth-Century Plebeian Home," *Home cultures* 11, no. 3 (2014). Susannah Ottoway, "Workload and Labour Discipline in the Eighteenth-Century Workhouse," in *Economic History Society Annual Meeting* (Royal Holloway, University of London2017).

[24] See Christine A. Jackson, ed., ed. *Newbury Kendrick Workhouse Records, 1627–1641* (Reading: Berkshire Record Society, 2004).

[25] Allen, "Spinning Their Wheels: A Reply to Jane Humphries and Benjamin Schneider," 12.

[26] Richard Guest, *A Compendious History of the Cotton-Manufacture: With a Disproval of the Claim of Sir R. Arkwright to the Invention of Its Ingenious Machinery* (Manchester: Joseph Pratt, Chapel Walks, 1823), 10–11. Allen also makes a passing reference to a 'pound-per-day' productivity figure in a French journal, but the source of the claim is again opaque. We noted in our earlier work that any attempted rehabilitation of Allen's comparative case would require observation of *actual* payments to French spinners (as opposed to commentators' claims).

Guest's main aim was not to identify the relative costs of different methods of production but to refute Richard Arkwright's claim to have invented the jenny. The estimates that Allen cites occur in a footnote reflecting back on conditions in the 1760s (the book was published in 1823). The source for Guest's figures is unknown.

In Guest's example spinning costs 9d per lb and the preparatory processes of picking, carding, and roving 9d per lb.[27] Allen says that Guest does not tell us how long it took to perform these tasks and therefore uses the relationship between day wages outside spinning and piece rates to compute productivity, inferring that it took 1.09 days to spin 1 lb of cotton: a daily productivity of almost 1 lb, Allen's benchmark. However, Guest *is* explicit that 'the weaving of a piece containing 12 pounds of eighteen-penny weft occupied a weaver about 14 days'.[28] The spinning cost 9s, the basis for Allen's 9d a lb. Guest's costing appears to be for balanced cycle times since he states that the weaver required 'three grown persons' to supply him with weft. Assuming half of these ancillary workers was employed in the preparatory processes, 1.5 spinners were needed to supply the 12 lbs of yarn over the 14-day production cycle. This suggests a productivity level of .57 lbs per day (12 lbs/ 14 (1.5)). Thus, while probably for full-time workers, Guest's assumed productivity was more like half than a full lb per day.

Allen's second 'new' source is the 1899 report on the comparative productivity of hand and machine methods of production compiled by the US Commissioner of Labor, Carroll Wright. To measure productivity and costs in hand production, Wright's agents first sought out examples in isolated rural areas. Allen emphasizes Wright's assurance that the identification of hand techniques was done with great care and the findings on productivity checked by experts. However, the Commission did not disclose the actual sources for either hand or machine methods, so we have no idea where the examples of cotton spinning by hand were found. It is difficult to imagine that by 1899 there were many—or any—hand spinners of raw cotton left in the United States. In fact, the authors of the report admitted that '[m]any

[27] The preparatory processes in cotton spinning were more labour intensive than in wool which was usually already combed when provided to spinners, see John Styles, "The Rise and Fall of the Spinning Jenny: Domestic Mechanisation in Eighteenth-Century Cotton Spinning," in *Explaining the British Industrial Revolution: textiles, technology and work* (California Institute of Technology2018).
[28] Guest, *A Compendious History of the Cotton-Manufacture: With a Disproval of the Claim of Sir R. Arkwright to the Invention of Its Ingenious Machinery*, 10.

of these [hand production] processes are not now in use at all', and acknowledged the difficulty of finding evidence about productivity.[29] It is likely then that Wright had to fall back on his second information-gathering strategy: 'the testimony of employers or workmen long since retired'.[30] But by 1899 were there any even 'long retired' hand spinners able to recollect their working hours, productivity, and wages? The report's authors may well have fallen back to secondary sources already used by Allen, perhaps even including Guest. Even if Wright's agents found a hand spinner in late 19th century America, she may have been spinning on a wheel with an 'accelerating' head, which was significantly more productive than the wheels used by British spinners in the 17th and 18th centuries.[31] The reliability of this source as an *independent account of 18th century spinners' productivity* is highly questionable.

In his discussion of the Commissioner of Labor's study, Allen notes the absence of children in hand spinning, an exclusion that he also finds in Guest's account. Children may have been absent or unmentioned in these rather odd accounts, but to deny their presence flies in the face of extensive historical evidence. The employment figures for spinning in Witney, for example, refer to a workforce 'from eight years old to decrepit old age'.[32] Children's spinning earnings also appear frequently in the printed sources used by Muldrew. Such workers appeared cheaper than adult women, but with traditional methods they could not approach the latter's productivity.[33] Even when vigorously incentivised as at the Lindsey spinning school, girls could not reach, let alone sustain, Allen's productivity claims. However, their employment was economic because they were paid by output.[34] To ignore children's work and wages not only leads to an overestimation of productivity and daily remuneration but also hides an important motive to mechanize: the desire to narrow the productivity gap

[29] 13th Report of the Commissioner of Labor, Vol. I, 6, 12–13.
[30] 13th Report of the Commissioner of Labor, Vol. I, 12.
[31] A 19th century account suggested that this technique was between 33% and 50% more productive than traditional spinning; James Leander Bishop, *A History of American Manufactures from 1608 to 1860* (Philadelphia1861), Volume 2, 167. James L. Garvin, "Report on the Piece Shops, Spofford Village, Chesterfield, New Hampshire," (Concord, NH: New Hampshire Division of Historical Resources, 2005).
[32] Plot, cited in Townley, *The Victoria History of the County of Oxford, Volume Xiv: Witney and Its Townships*, 80.
[33] Arthur Young gives some information on children's wages in spinning; Young, *Six Months Tour*, Vol. II, 335, 425; Vol. III, 192.
[34] Barnsley Archives, EM/985. We thank Jo Innes for sharing her preliminary analysis of this source.

between children and adults through new machines and work practices, and so release the potential of child labour.[35]

Allen also cites Thomas Jefferson's *Farm Book* (1953) as 'superficially' appearing to provide information on productivity in the hand spinning of wool, linen and cotton. Ironically, he rejects this source because 'the values are not measurements of actual work but claims of equipment manufacturers or his [Jefferson's] own planning projections….', that is because it is *hearsay*.[36] Jefferson set his experienced female slaves to spin different fibres to establish 'what may be spun daily'. The women were obliged to spin diligently during daylight hours, not just because they were enslaved but also because Jefferson wanted to establish productivity benchmarks. The records enable computation of output per day across the year. For linen the average output was 19 oz per day, for short staple wool 15 oz but for cotton 8 oz (and this is assuming the women spun all daylight hours, so 12–14 hours from spring to early autumn). The slaves were spinning coarse yarns for slave clothing and bedding, and doing so under duress, yet it was only for linen yarn, spun from hemp fibre, (the easiest to process), that output reached 1 lb per day.

While we have reservations about the comparability of slave and free labour and cannot be sure exactly how these experiments were conducted, important conclusions emerge. First, Jefferson provides a useful contemporary estimate of maximum daily and even hourly hand spinning productivity under closely supervised conditions and involving skilled workers. Since the duration of the experiments is unknown, and hourly productivity remains suspiciously constant regardless of the length of the working day, it seems likely that Jefferson had the women spinning for a stretch, observed productivity per hour and then multiplied it by the number of daylight hours to estimate what could be produced in each season.[37] But in this case the resulting numbers represent *maximum* productivity which would have been hard to maintain over several days or weeks. At any rate, given Jefferson's systematic practice in

[35] For the employment implications of narrowing the productivity gap between children and adults, see Kaushik Basu and Pham Hoang Van, "The Economics of Child Labor," *The American Economic Review* 88, no. 3 (1998). Jane Humphries, "Childhood and Child Labour in the British Industrial Revolution," *The Economic History Review* 66, no. 2 (2013).

[36] Allen, "Spinning Their Wheels: A Reply to Jane Humphries and Benjamin Schneider," note 9.

[37] This might well have been the case since although the table is not dated the context seems to have been his deliberations whether or not to acquire a spinning jenny. We thank John Styles for discussion of this source.

his scientific and economic investigations, the productivity estimates deserve to be taken at least as seriously as numbers produced by contemporary social commentators who often had little background but several axes to grind. Second, hand spinning of cotton emerges as very slow in comparison with the other fibres, a finding confirmed by experienced modern hand spinners.[38] The bottom line is that these figures (surely more credible that Wright's estimates) bolster our position on productivity.

IV

A key point of the debate is, of course, daily wages. Allen largely—but not entirely, as we note below—stands by his earlier numbers. He describes these as 'my estimates' and 'my series'. In fact, they are claims made about spinners' time rates (sometimes constructed from assumptions about productivity and piece rates) found in secondary sources and reported in a seminal article by Muldrew.[39] For the years 1588–1750, Allen relays only 6 estimates of spinners' earnings, fewer than 4 per century! In comparison with these point estimates, Allen expresses alarm at the variance in our series.[40] However, variation is to be expected in actual historical data, here partially accounted for by sub-dividing by source, fibre and type of labour as summarised in Table 6.[41]

Allen's 'Restatement' (and his webpage data) extends the series through the Industrial Revolution using Feinstein's data for hand spinners.[42] Feinstein cites as his sources the now well-worn set of social commentators.[43] In our earlier paper, we argued that such sources are

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[38] Personal communication from Anne McCants. Some of the reasons are rehearsed in A. F. Barker, *Textiles*, Rev. ed. (London: Constable, 1922), 110–11. For further detail see Styles, "The Rise and Fall of the Spinning Jenny: Domestic Mechanisation in Eighteenth-Century Cotton Spinning."

[39] Craig Muldrew, "'Th'ancient Distaff' and 'Whirling Spindle': Measuring the Contribution of Spinning to Household Earnings and the National Economy in England, 1550–1770," *The Economic History Review* 65, no. 2 (2012).

[40] Allen contends that the variability of our data undermines its credibility, in comparison with, for example, Mann's table of spinning rates. However, it too shows wide dispersion in rates paid for several dates (most notably 1677, 1760, and 1789). Julia de Lacy Mann, *The Cloth Industry in the West of England from 1640 to 1880* (Oxford: Clarendon Press, 1971), 322–25.

[41] Humphries and Schneider, "Spinning the Industrial Revolution," 146. ibid.

[42] Allen, "The High Wage Economy and the Industrial Revolution: A Restatement," 15. ibid.

[43] Charles Feinstein, "Wage-Earnings in Great Britain During the Industrial Revolution," in *Applied Economics and Public Policy*, ed. Iain Begg and S. G. B. Henry (Cambridge: Cambridge University Press, 1998), 189.

not to be trusted (a view supported by simple regression analysis) and we contrasted pundits' claims with data that related to actual payments made to spinners.

Against our evidence from business records, Allen sets Defoe's much-cited complaint about farmers' inability to recruit female servants because hand spinners could earn so much more. Defoe's comment accompanies an estimate of potential earnings so high (7–8s a week) that, if correct, it would have persuaded not only male farm labourers (earning perhaps 5s a week) but some skilled artisans to sit at the wheel![44] Moreover, Allen claims inadmissible the wage observations that we categorize as indirect claims (which include observations drawn from Defoe, Arthur Young, Frederick Eden, and other social commentators), because they 'are hard to assess without a case-by-case examination to ascertain whether the wage reported is that of a full-time or a part-time worker […] [i]n many cases, it is impossible to say'—but *these are the sources* for *his* claims about spinners' remuneration.[45] Allen's newfound skepticism about hearsay earning levels leaves readers entirely in the dark about what evidence he proposes as an alternative, robust source of information on spinners' earnings over the 17th and 18th centuries.

Moreover, as noted above, a crucial aspect of the earlier data presented by Allen has disappeared: the claim to earnings of 12d per day in 1770. This provided the peak of spinners' earnings coincident with mechanization and a smoking gun trained on their causal role,[46] but it is now dropped *without explanation*.[47] Absent the 12d figure, the series that Allen has spliced together from secondary sources shows stable nominal wages from 1750–1779. Why then would the three spinning inventions have clustered in the decade after 1764? His claim to

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[44] Defoe, *Behaviour of Servants in England*, quoted in Ivy Pinchbeck, *Women Workers and the Industrial Revolution, 1750–1850* (London: George Routledge & Sons, Ltd, 1930), 140. Sharpe notes that this figure relates to high rates prevailing in trade upswings and that 'the normal weekly rate… was only a third' of the Defoe estimate, Sharpe, *Adapting to Capitalism: Working Women in the English Economy, 1700–1850*, 31.

[45] The social commentators' evidence and pamphlets, which we include and categorize as indirect claims, were the main source for Muldrew's series which, in turn, made up the entirety of Allen's early modern wage series.

[46] Allen, "The High Wage Economy and the Industrial Revolution: A Restatement," 15.

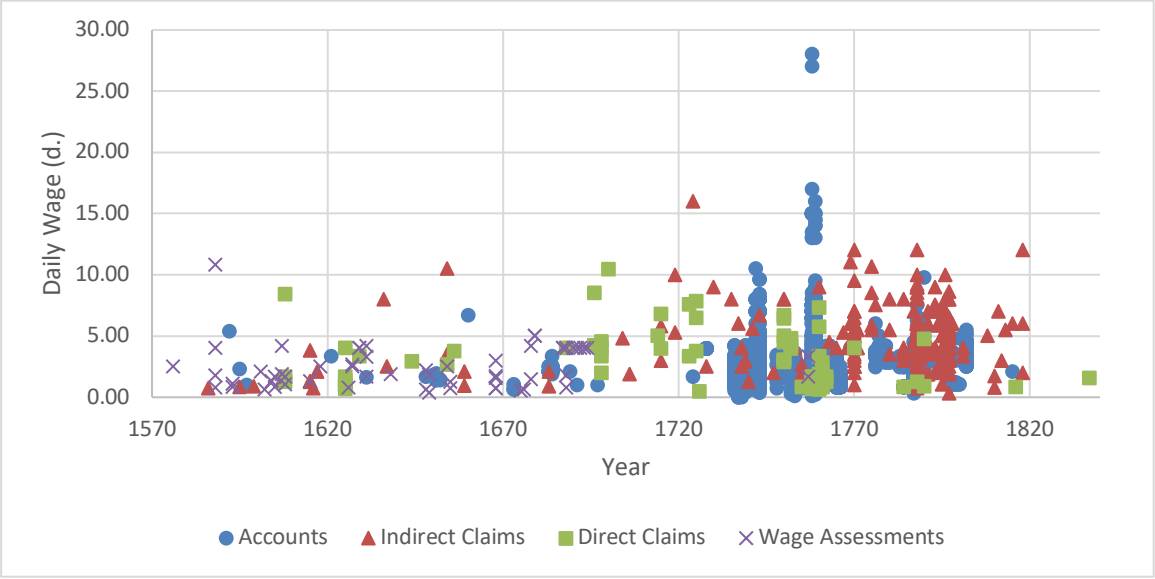
[47] The observation was based on the paper by Charles Feinstein, cited above, n. 46, which used secondary sources and was accompanied by advice on cautious usage, see Feinstein, "Wage-Earnings in Great Britain During the Industrial Revolution," 189. This observation is likely drawn from a single comment by Arthur Young in 1771. Allen uses Feinstein's series of *cotton* spinning earnings as representative of all spinners' earnings and treats the two as interchangeable.

explain both British industrialization *and its timing* cannot be sustained, even using the evidence from secondary sources on which he relies.[48]

V

We have added 1726 new observations from 16 fresh sources to our database, most of which relate to *actual* payments and piece rates. Again, we drew on contemporary observers, the 'indirect claims' relied on by earlier investigators including Allen, but about which we have reservations. We supplemented this standard—but we think dubious—source with claims by commentators from within the textile industry, our 'direct claims', and additional 'wage assessments,' which are available particularly for the earlier period. However, the most reliable source is surviving 'accounts' which provide concrete evidence on wages and rates paid. Where possible we continued to record the fibre spun and the age and gender of the worker.[49] As before, where we have data on the piece rate and productivity we have constructed daily earnings and controlled for the construction in later analysis.[50]

Figure 1: Daily wages by source type, nominal d.



Sources: see the online appendix to Humphries & Schneider (2019), the archival and printed sources sections of the bibliography, and the text.

[48] Allen, "The High Wage Economy and the Industrial Revolution: A Restatement," 14.
[49] We assume a six-day working week and wages based on longer periods have been converted into day rates.
[50] 51 per cent of the sample observations are constructed in this way. For more detail on our method, see Humphries and Schneider, "Spinning the Industrial Revolution," 141–43.

Figure 1 replicates the scatter plot by type of observation included in the original paper.[51] It illustrates the same findings. Even the indirect claims are more pessimistic than suggested in the high wage economy thesis and the pessimism mounts as before when we admit estimates from our more trusted sources such as account books. The same outliers remain, probably the work of multiple spinners or provided by interested parties such as Defoe. Aside from these, while our data broadly match that of Muldrew for the early seventeenth century, there was no general increase in earnings by the mid-eighteenth century. Six pence per day may have been possible for some spinners in 1700, but the vast majority of observations were below 8d around 1750 and the now excised 12d in 1770 was clearly fanciful.

Table 1 shows the results of replicating the regression analysis of the logarithm of daily wages on the date of the observation while controlling for source, fibre, and age and gender of the spinner used in the original paper to explore the determinants of wages.

Table 1: Spinners' Wages by Source, Fibre, and Type of Labour

Constant	-2.435** (.706)	-2.629** (.707)
Year	.002** (.000)	.002** (.000)
Source:		
Accounts	-.457** (.036)	-.440** (.036)
Direct Claims	-.502** (.070)	-.438** (.072)
Wage Assessments	-.548** (.094)	-.489** (.095)
Fibre:		
Cotton	-.223** (.085)	-.213** (.085)
Flax	.079 (.046)	.043 (.047)
Hemp	-.121 (.084)	-.126 (.084)
Tow	-.635* (.268)	-.590* (.268)
Wool	-.113** (.041)	-.132** (.041)
Labour:		
Boys	-.458** (.048)	-.494** (.049)

[51] Our dataset for the original paper used Defoe's implausibly optimistic figures twice, as they appeared on separate pages. We have removed the lower observation as we considered this to be duplicative. We also removed one further duplicative observation from Dorset in 1608.

Children	-.485** (.021)	-.422** (.027)
Girls	-.662** (.032)	-.697** (.033)
Men	.033 (.052)	.002 (.052)
Women	-.027 (.030)	-.052 (.031)
Wage Construction		
Productivity x Piece rate		-.104** (.026)
R^2 (adj)	.282	.284
SEE	.528	.527
F	121.136**	114.466**
N	4283	4283

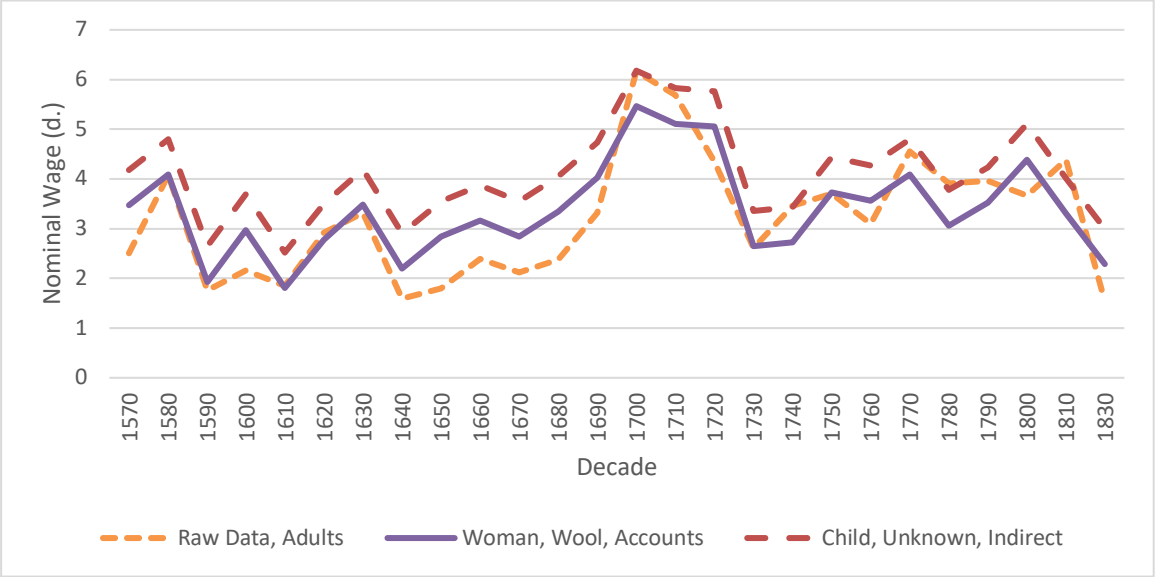
Notes: The dependent variable is the natural logarithm of the nominal daily wage. Coefficients are reported with standard errors in parentheses. ** and * indicate significance at the 1% and 5% levels. Bootstrapping made only small differences to the standard errors and no differences to the variables judged significant.

To track the development of earning levels over time while controlling for variation in our sample by worker type and fibre, we have constructed wage profiles for various stylised spinners using the coefficients from a regression of nominal wages on our controls but replacing year by decade dummies.[52] Figure 2 compares two profiles that control for heterogeneity in the underlying data with the mean daily wages for all adults in the sample, whatever the source of data or fibre being worked. The first represents the wage earned by an adult woman spinning wool as recorded in accounts. The second shows the wages earned by children as stated in contemporary social commentators' writings. As is obvious from the regression results, children's wages reported by social commentators exceeded those recorded as paid to adult women in surviving account books, demonstrating the implausible optimism of the social commentators' claims.

The evolution of spinners' wages remains subject to short term movements in the early eighteenth century in part because of the scarcity of data and some extreme observations. While we still see an apparent boom *circa* 1710, this is swiftly followed by a return to more traditional levels. It is hard to see this record as participation in a high wage economy.

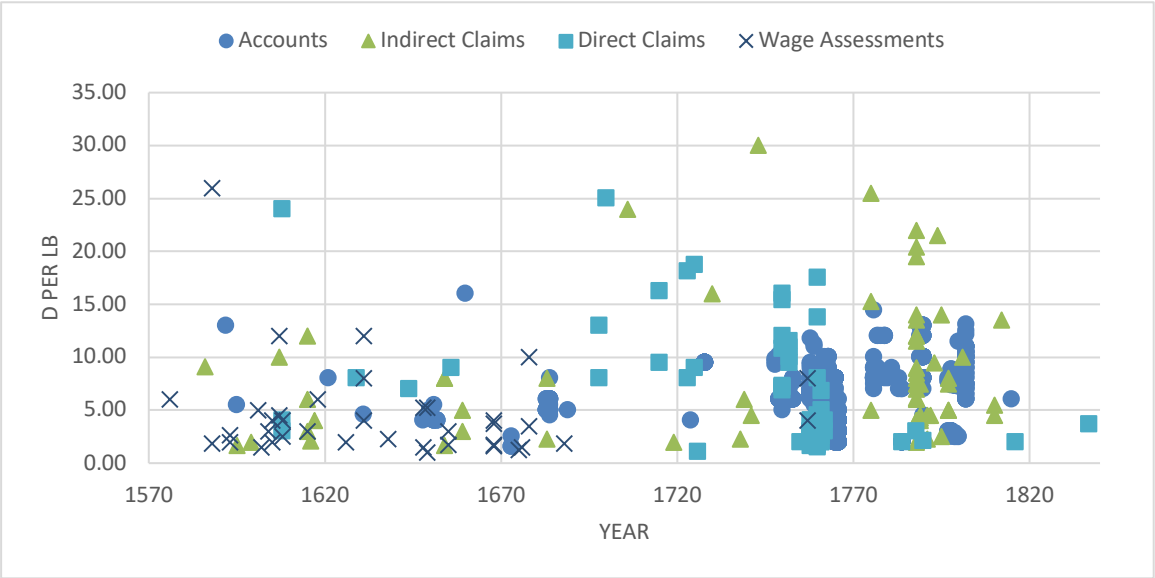
[52] We regress nominal wages in pence per day on categorical variables for type of source, fibre, worker, and a series of decade dummies benchmarked against 1770, over half of which are statistically significant. The resulting coefficients are used below to control for type of source, worker, and fibre while tracking evolution by decade. The regression is reported in the appendix below.

Figure 2: Wage profiles of certain stylised hand spinners



Sources: see the online appendix to Humphries & Schneider (2019), the archival and printed sources sections of the bibliography, the appendix to this paper, and the text.

Figure 3: Piece rates by source type, nominal d.



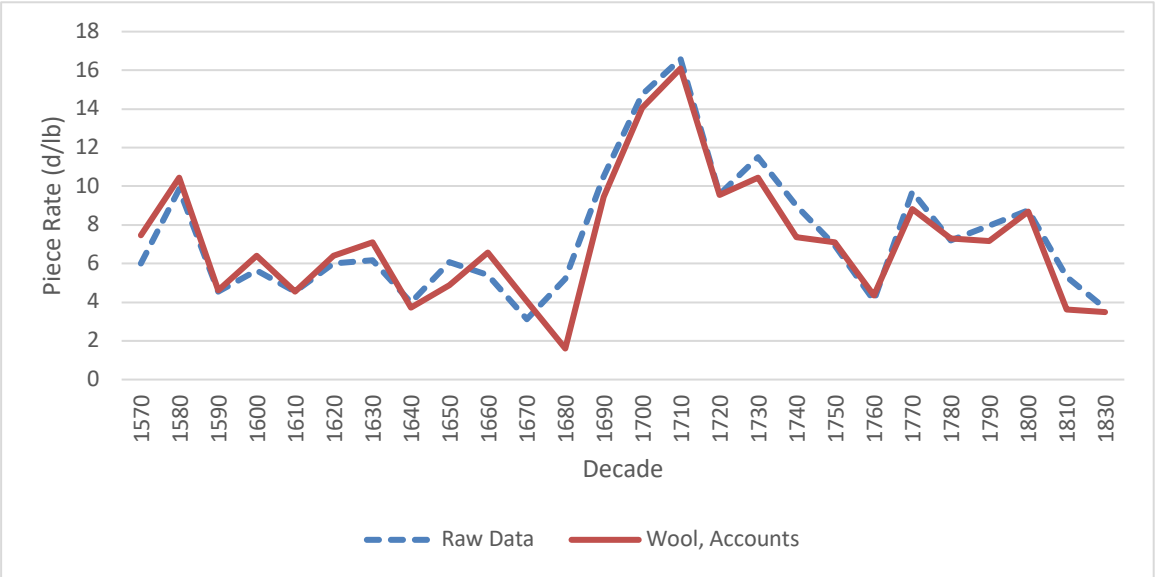
Sources: see the online appendix to Humphries & Schneider (2019), the archival and printed sources sections of the bibliography, and the text.

Finally, while Allen and our initial paper focused on daily earnings, the primary incentive to innovate would have been the unit cost of spinning: the piece rate.[53] So as well as using our 2187 observations of piece rates to construct estimates of daily wages, we also

[53] For a discussion of unit costs and innovation, see Morgan Kelly, Joel Mokyr, and Cormac Ó Gráda, "Precocious Albion: A New Interpretation of the British Industrial Revolution," *Annual Review of Economics* 6, no. 1 (2014).

investigated trends over time in the piece rates themselves. Shortages of yarn would have shown up in market prices, inflated rates heralding the invention of the jenny. Improvements in cloth quality as well as a small rise in prices over the century preceding the spinning innovations might be expected to increase piece rates. Controlling for source, worker and fibre, there is no statistically significant time trend in the data. While there is substantial short-term variation in rates averaged by decades, neither the raw data nor indices constructed to control for heterogeneity show a boom *circa* 1760. Figure 4 compares the all-sample decade average piece rates with the rates for spinning wool captured in business and household accounts constructed, as above, from the coefficients of a regression analysis of piece rates on our standard controls. Any increase, as in the wage evidence above, occurred much earlier, while the decades preceding mechanization saw a return to more customary levels.[54] There is no evidence that circa 1760 the unit costs of spinning rose presaging, indeed promoting, the invention of the jenny, water frame, and mule.

Figure 4: Nominal piece rates, raw data and constructed from regression analysis



Sources: see the online appendix to Humphries & Schneider (2019), the archival and printed sources sections of the bibliography, the appendix to this paper, and the text.

VI

The challenges Allen makes to our archival data, like his earlier claims about spinners' work and earnings, rest on limited contemporary evidence, frequently of an incidental kind

[54] As with daily wages, there are few observations of piece rates that compose the possible peak at the beginning of the 18th century.

and involving recycled guesstimates. We agree that spinners likely worked part-time but according to rhythms very different from those Allen assumes. We contend that when fibre was available spinners often worked long hours and that as a result most of our observations are analogous to Allen's 'full-time equivalents'. We reject Allen's implausible claim that although they were poor, spinners limited their working hours per day and days per year, sacrificing opportunities to earn.

We defend our expanded series, which is based on a large body of evidence relating to *actual* payments to often *named* spinners for *specific amounts and types of work*. Our figures for daily earnings are reinforced by an analysis of observed piece rates, which do *not* show a trend consistent with induced mechanization.[55] Spinners were sometimes—but not always—unskilled and young, they were usually poor, and their work was on occasion mediated by the poor law and even penal authorities. Some may have worked discontinuously. But this was the reality of the spinning work force in preindustrial England. Making such workers more productive and their output more consistent was what motivated the early textile inventors and innovators. The jenny, Allen's archetype response to his mythically high wages, was intended to be worked by adolescents. Experimentation with prototype machines at the North-Western Museum of Science in the 1970s demonstrated that they were ill-adapted to adult operators: '…the bent posture, the reach of the right hand to the wheel, the difficult co-ordination of the two hands and foot, all make this a most uncomfortable machine to work. Adult jenny spinners must have been bent double and soon have developed back ache'.[56] Ogden gave a full account: 'The awkward posture required to spin on [hand jennies] was discouraging to grown up people, while they saw, with a degree of surprize, children from nine to twelve years of age, manage them with dexterity'.[57] Berg concludes that 'the original

[55] This is not to dispute problems with the supply of some yarn, particularly difficult-to-spin cotton, in certain regions at particular times, see Styles, "The Rise and Fall of the Spinning Jenny: Domestic Mechanisation in Eighteenth-Century Cotton Spinning." See also "Robert Allen's Spinning Jenny Is Still Broken".

[56] R. L. Hills, "Hargreaves, Arkwright and Crompton: Why Three Inventors?," *Textile History* 10, no. 1 (1979): 119.

[57] Cited in C. Aspin, *James Hargreaves and the Spinning Jenny* (Preston: Helmshore Local History Society, 1964), 48.

jenny was best suited to being worked by children'.[58] Rather than saving time for adult women, as Allen's model implies, it made children more productive.

Although it did bridge the productivity gap between women and children and so cheapened the supply of yarn, the jenny did not go far enough in this endeavour, nor did it solve the technical problems that the industry increasingly faced, particularly in its attempts to produce the finer all-cotton cloths hitherto supplied by India.[59] Some of these problems were partially addressed by the transition to larger jennies housed in workshops, for the domestic phase of jenny production was very short lived. More extensive and lasting solutions required different technical and organizational arrangements: the water frame, mule spinning, and above all the factory system.

Many factors contributed to the emergence of mechanized spinning in the north-west of England, but while it left in its wake thousands of stranded and impoverished spinsters elsewhere in the country, it was never propelled by a widespread ability to earn 8d or 12d a day. Contemporary sources, whether the descriptions of social commentators or records of actual payments made, show that the large majority of spinners earned far less than this. In his theory-driven insistence on high wages in all corners of the eighteenth-century British economy, Robert Allen has lost the thread of empirical evidence that connects economic historians to the subjects of their study.

[58] Maxine Berg, *The Age of Manufactures : Industry, Innovation and Work in Britain, 1700–1820* (New York: Oxford University Press, 1986), 254.
[59] Styles, "The Rise and Fall of the Spinning Jenny: Domestic Mechanisation in Eighteenth-Century Cotton Spinning."

Appendix

Hedonic Regression for Nominal Wages

Source	*SS*	*df*	*MS*
Model	4994.77243	39	128.071088
Residual	11523.6705	4,243	2.71592517
Total	16518.4429	4,282	3.85764664

Number of obs	=	4,283
F (39, 4243)	=	47.16
Prob > F	=	0.0000
R-squared	=	0.3024
Adj R-squared	=	0.2960
Root MSE	=	1.648

	Coefficient	*Std. Error*	*t*	*P > |t|*	*95% Confidence Interval*	
Source Type						
Accounts	-1.56391	.137253	-11.39	0.000	-1.832997	-1.294822
Direct Claims	-1.51029	.2506558	-6.03	0.000	-2.001707	-1.018874
Wage Assessments	-1.728883	.3431561	-5.04	0.000	-2.401649	-1.056118
Fibre						
Cotton	-.4622495	.3314529	-1.39	0.163	-1.112071	.1875716
Flax	.5736457	.1821075	3.15	0.002	.2166197	.9306717
Hemp	-.3094961	.2862338	-1.08	0.280	-.8706641	.2516718
Tow	-1.42677	.862404	-1.65	0.098	-3.117533	.2639934
Wool	-.029613	.1444968	-0.20	0.838	-.3129024	.2536765
Labour Type						
Boys	-1.198439	.1948457	-6.15	0.000	-1.580438	-.8164392
Children	-1.052322	.2175932	-4.84	0.000	-1.478919	-.625726
Girls	-1.537185	.1498105	-10.26	0.000	-1.830892	-1.243478
Men	-.2173912	.2060186	-1.06	0.291	-.6212955	.186513
Women	-.1718576	.1329088	-1.29	0.196	-.4324283	.0887132
Constructions						
Productivity	-.9727061	.1075156	-9.05	0.000	-1.183493	-.7619193
Decades						
1570–1579	-.6253631	1.693602	-0.37	0.712	-3.945709	2.694983
1580–1589	-.0047538	.8073264	-0.01	0.995	-1.587536	1.578028
1590–1599	-2.161942	.659005	-3.28	0.001	-3.453937	-.8699475
1600–1609	-1.118105	.5583126	-2.00	0.045	-2.21269	-.0235203
1610–1619	-2.284721	.6789166	-3.37	0.001	-3.615752	-.9536888
1620–1629	-1.309276	.5214257	-2.51	0.012	-2.331544	-.287009
1630–1639	-.6067649	.6817006	-0.89	0.373	-1.943255	.729725
1640–1649	-1.897647	.7377099	-2.57	0.010	-3.343945	-.45135
1650–1659	-1.255235	.4223458	-2.97	0.003	-2.083253	-.4272161

1660–1669	-.9305974	.7518285	-1.24	0.216	-2.404575	.5433799
1670–1679	-1.256248	.6250339	-2.01	0.045	-2.481642	-.030855
1680–1689	-.7486879	.4179677	-1.79	0.073	-1.568123	.0707475
1690–1699	-.0656334	.5395512	-0.12	0.903	-1.123436	.9921693
1700–1709	1.374185	.9769523	1.41	0.160	-.541153	3.289523
1710–1719	1.018039	.6594541	1.54	0.123	-.2748357	2.310914
1720–1729	.9649023	.3648749	2.64	0.008	.2495566	1.680248
1730–1739	-1.444671	.2429422	-5.95	0.000	-1.920965	-.9683771
1740–1749	-1.368325	.2519622	-5.43	0.000	-1.862303	-.8743474
1750–1759	-.3638357	.2289436	-1.59	0.112	-.812685	.0850135
1760–1769	-.5348177	.29584	-1.81	0.071	-1.114819	.0451835
1780–1789	-1.026393	.2241857	-4.58	0.000	-1.465914	-.5868714
1790–1799	-.567082	.2178547	-2.60	0.009	-.9941912	-.1399728
1800–1809	.3004599	.2831387	1.06	0.289	-.2546402	.8555599
1810–1819	-.7913286	.535087	-1.48	0.139	-1.840379	.2577218
1830–1839	-1.805226	1.674046	-1.08	0.281	-5.087232	1.47678
Constant	5.856565	.2277192	25.72	0.000	5.410117	6.303014

Notes: The dependent variable is the nominal daily wage in pence. The reference categories are indirect claims, unknown fibre (which was likely wool), unknown worker (likely women), and 1770–1779. The Hand Spinners' Wages Dataset contains no observations for the decade 1820–1829.

Hedonic Regression for Piece Rates

Source	*SS*	*df*	*MS*
Model	7996.39415	38	210.431425
Residual	8886.01285	2,148	4.13687749
Total	16882.407	2,186	7.72296752

Number of obs	=	2,187
F (38, 2148)	=	50.87
Prob > F	=	0.0000
R-squared	=	0.4737
Adj R-squared	=	0.4643
Root MSE	=	2.0339

	Coefficient	*Std. Error*	*t*	*P > |t|*	*95% Confidence Interval*	
Source Type						
Accounts	-1.071051	.3633256	-2.95	0.003	-1.783558	-.3585449
Direct Claims	-.8759002	.4757775	-1.84	0.066	-1.808933	.0571323
Wage Assessments	-2.521775	.5831852	-4.32	0.000	-3.665441	-1.378108
Fibre						
Cotton	3.846078	1.111753	3.46	0.001	1.665854	6.026301
Flax	2.270925	.3502194	6.48	0.000	1.58412	2.957729
Hemp	-.5843719	.6622072	-0.88	0.378	-1.883006	.7142621
Tow	-1.847704	1.280316	-1.44	0.149	-4.358492	.6630832

Wool	-.1212277	.3111442	-0.39	0.697	-.7314031	.4889476
Labour Type						
Boys	-4.132481	2.066258	-2.00	0.046	-8.184555	-.080407
Children	-.2630298	.581193	-0.45	0.651	-1.402789	.8767298
Girls	10.66196	1.616432	6.60	0.000	7.492026	13.8319
Men	.9069702	2.04413	0.44	0.657	-3.10171	4.915651
Women	-.8013674	.3805092	-2.11	0.035	-1.547572	-.0551625
Decades						
1570–1579	-1.369377	2.13203	-0.64	0.521	-5.550436	2.811681
1580–1589	1.609622	1.273281	1.26	0.206	-.8873709	4.106615
1590–1599	-4.195619	.9146037	-4.59	0.000	-5.98922	-2.402018
1600–1609	-2.429237	.7728216	-3.14	0.002	-3.944793	-.9136803
1610–1619	-4.266667	.9121791	-4.68	0.000	-6.055513	-2.477821
1620–1629	-2.401577	1.251342	-1.92	0.055	-4.855545	.0523916
1630–1639	-1.71505	1.075743	-1.59	0.111	-3.824656	.3945565
1640–1649	-5.101758	.9617783	-5.30	0.000	-6.987871	-3.215644
1650–1659	-3.945266	.6983438	-5.65	0.000	-5.314766	-2.575765
1660–1669	-2.263767	1.057736	-2.14	0.032	-4.338061	-.1894739
1670–1679	-4.753778	.9132301	-5.21	0.000	-6.544685	-2.96287
1680–1689	-7.215202	1.099415	-6.56	0.000	-9.371231	-5.059172
1690–1699	.6287419	1.527529	0.41	0.681	-2.366847	3.624331
1700–1709	5.236184	1.489496	3.52	0.000	2.31518	8.157189
1710–1719	7.276115	1.251733	5.81	0.000	4.821379	9.73085
1720–1729	.7396988	.5503821	1.34	0.179	-.3396384	1.819036
1730–1739	1.608848	1.261792	1.28	0.202	-.8656126	4.083309
1740–1749	-1.452382	.6035871	-2.41	0.016	-2.636058	-.2687058
1750–1759	-1.727071	.4249265	-4.06	0.000	-2.560381	-.8937607
1760–1769	-4.470239	.6758382	-6.61	0.000	-5.795604	-3.144874
1780–1789	-1.508671	.457459	-3.30	0.001	-2.40578	-.6115624
1790–1799	-1.667893	.3878691	-4.30	0.000	-2.428531	-.9072552
1800–1809	-.1280253	.4596184	-0.28	0.781	-1.029369	.7733181
1810–1819	-5.207114	.9820422	-5.30	0.000	-7.132966	-3.281261
1830–1839	-5.325252	2.094652	-2.54	0.011	-9.43301	-1.217494
Constant	10.01238	.4639304	21.58	0.000	9.10258	10.92218

Notes: The dependent variable is the nominal piece rate in pence per lb of yarn. The reference categories are indirect claims, unknown fibre (which was likely wool), unknown worker (likely women), and 1770–1779. The Hand Spinners' Wages Dataset contains no observations for the decade 1820–1829.

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