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When Piece Rates Work: More Lessons from the Cotton Mills

Michael Huberman[†]

Abstract / Résumé

Workers paid by the piece should in principle cooperate with new techniques that increase their output. In practice, however, firms seem unable to keep piece rates fixed, and when they cut rates workers often respond by restricting output. This paper investigates a case where in fact firms abstained from cutting rates and workers refrained from reducing effort. In Lancashire cotton spinning workers and firms negotiated piece rate lists which fixed standard rates of pay. Both parties had incentives to keep at bay the forces of competition. The lists gave workers a share in the gains of technical change, and they allowed firms to reap the benefits of regional specialisation. The lists were enforced by community standards.

Les travailleurs payés à la pièce devraient en principe coopérer avec l'avènement de nouvelles technologies qui augmentent leur production. En pratique toutefois, les firmes semblent incapables de conserver un taux à la pièce fixe et quand elles coupent les taux, les travailleurs répondent souvent en restreignant leur production. Ce texte examine un cas où dans les faits les firmes se sont abstenues de couper les taux et les travailleurs eux, se sont abstenus de réduire leurs efforts. Dans le Lancashire, les ouvriers des filatures de coton et les firmes ont négociés des listes de taux à la pièce qui fixait les taux standards à payer. Les deux parties trouvaient leur avantage à tenir en échec les forces de la compétition. Les listes donnaient aux travailleurs un profit sur les changements technologiques et elles permettaient aux firmes de récolter les bénéfices de la spécialisation régionale. Les listes étaient maintenues selon les standards des communautés du Lancashire.

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Workers paid by the piece should in principle cooperate with new techniques that increase their output, and hence their earnings. But in practice firms are reluctant to keep piece rates constant when output per worker rises. Daniel Nelson observed this phenomenon in late nineteenth century American manufacturing:

> "Whenever piece work was introduced and workers began to receive significantly higher pay than they had under the day wage system, the manufacturer was tempted to cut the rate so the wage earners, though producing more, would earn approximately what they had under day work."[1]

In response to reduced piece rates, or 'rate busting', workers have frequently resorted to restricting output. David Montgomery has provided numerous examples of workers during rapid industrialization responding to piece rate cuts by withholding effort, or what Thorstein Veblen referred to as the "conscientious withdrawal of efficiency."[2] In his classic study Stanley Matthewson recorded a similar response of unorganized workers to employers' attempts to cut piece rates in the 1930s.[3] In many instance firms cut piece rates despite their better judgment and that of industrial relation experts. "[E]xperience proves that if you want your men to do their level best," D. F. Schloss, a pioneer in the study of methods of remuneration, wrote, "you must rigorously abstain from nibbling their wages down, even if it be demonstrable that a mistake in their favor has been made in fixing prices."[4] Why do firms, then, cut piece rates? This paper proposes an answer to this question by examining a case where firms in fact refrained from rate busting.

At the end of the nineteenth century Lancashire cotton spinners were paid by wage or piece rate lists that stipulated prices paid for spinning yarn of different grades, on spinning mules of various sizes, and for different speeds of production. The lists fixed a standard rate of pay, and while cyclical adjustments of 5-10 percent above and below the standard were made, the wage list itself was left intact. The major lists were centered in the Bolton and Oldham cotton spinning districts; the former regulated wages in fine-spinning, the latter in coarse-spinning areas. The two lists determined

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[1] Daniel Nelson, *Managers and Workers: Origins of the Factory System in the United States* (Madison, 1975), p. 45.

[2] David Montgomery, *Workers' Control in America: Studies in the History of Work, Technology, and Labor Struggles* (New York, 1979); Thorstein Veblen, *The Engineers and the Price System* (New York, 1922).

[3] Stanley Matthewson, *Restriction of Output Among Organized* Workers (New York, 1931).

[4] David Schloss, *Methods of Industrial Remuneration* (Oxford, 1898), 73.

the earnings of 75 percent of spinners in Lancashire and were well established institutions, governing industrial relations as the "force of laws."[5] Despite their importance, the origins of the lists and their makeup remain uncertain. Even Sidney and Beatrice Webb were reluctant to address these issues. "It is difficult to convey to the general reader," they wrote, "any adequate idea of the important effect which the elaborate [spinning lists] have had in Lancashire. [Yet] the principles upon which the lists are framed are so complicated that we confess, after prolonged study, to be still perplexed on certain points."[6]

The point of departure of this paper is based on the common distinction between two types of increases in average productivity. The first is associated with capital deepening, increasing the size of spinning mules, for instance; the second is associated with firm-specific, or mule-specific, skills. Where earnings and productivity rise because of these skills, rate busting by firms is not justified. But where firms invest in new equipment, rate busting is almost unavoidable.

In general firms appear to be unable to abstain from rate cutting because of competition.[7] Consider the case where a firm introduces a new technology without adjusting rates. Workers gain experience in the new technology and their output and earnings rise. But cooperation between firms and workers is short-lived because new technologies and skills spread from one firm to another. Other firms, perhaps started by ex-employees of the first, can always undercut the innovating firm by starting up a new operation, teaching the new techniques, and setting a lower piece rate. Even where individual firms and workers wish to protect piece rates, the forces of competition overwhelm them. Thus, Nelson cites the manager of a boot and shoe factory who first calculated the average production per worker in his enterprise, but then only set the rate after measuring it against his competitors. "If no one in our town has a piece price we compare it with factories in other towns, and if we are not much too low or too high, we put it [piece rate] in."[8]

In Lancashire, cotton spinning was concentrated within a small region. Manchester was the hub, distances between towns were not great, and ideas flowed easily. Technical change was rapid in the first half of the century. In addition, the

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[5] William Taggart, *Cotton Mill Management: A Practical Guide for Managers, Carders and Overlookers* (London, 1923).

[6] Sidney and Beatrice Webb, *The History of Trade Unionism* (New York, 1894), 308. Many of the technical aspects of the lists are well explained by John Jewkes and E. M. Gray, *Wages and Labour in the Lancashire Cotton Spinning Industry* (Manchester, 1935). William Lazonick, *Competitive Advantage on the Shop Floor* (Cambridge, Mass., 1990).

[7] For an elaboration, see H. Lorne Carmicheal and W. Bentley MacLeod, "Worker Cooperation and the Ratchet Effect," paper prepared for the Osaka University Symposium, Osaka, Japan, Nov. 1992.

[8] Nelson, *Managers and Workers*, 45.

makeup of the lists were inherently unstable. The Bolton fine-spinning list stipulated lower coarse-spinning prices than the Oldham list; while the latter paid lower fine-spinning prices than the Bolton list. Given mobile capital, it would have been expected that the lists would have broken down. But in Lancashire the wage lists withstood these pressures and they became well established. Although capital deepening continued throughout the century, from about 1850 on increased worker effort contributed significantly to productivity growth. Earnings also rose, but employers held back slashing piece rates.

This contrasts with the experience of the textile industry in Fall River, Massachusetts where wage lists played a less important role.[9] The New England's male's spinner pay was greater because of the much more abundant alternative opportunities in the United States for a strong, hard-working man. As one would expect, technical and organizational change was more rapid, but the accumulation of firm specific skills was limited because worker mobility was greater. Spinners, as Lazonick has written, were more mobile not only form mill to mill within the textile region of Fall River, but also from region to region, and from one occupation to another.[10] In contrast to Lancashire, rate busting and rapid technical and organizational change continued throughout the century.

If the Lancashire episode proved difficult to emulate, why does payment by result persist? Payment by piece has a long tradition, predating the putting-out stage, and conditions were propitious for its adoption in the first factories. In cotton textiles, output was easily measured and it was difficult to monitor the time necessary to complete a task. For Britain, as Schloss and others observed, the proportion of manufacturing workers paid by the piece was on the increase for the first half of the century; while for Germany it has been estimated that by 1914 about half of the industrial labor force worked mainly on piece rates.[11] In Britain in 1961, 33 percent of workers were still paid by the piece, and in the United States from 1890 to 1958 the percentage of production workers on piecework remained between 25-30 percent.[12]

The development of the Lancashire lists sheds light on the question of persistence. A feature of 'mature' labor markets in which regular communications

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[9] On lists in New England, see Lazonick, *Competitive Advantage*; Isaac Cohen, *American Management and British Labor: A Comparative Study of the Cotton Spinning Industry* (Westport, Connecticut, 1990).

[10] Lazonick, *Competitive Advantage*, 126.

[11] J. J. Lee, "Labour in German Industrialization," in Peter Mathias and Michael Postan, eds., *The Cambridge Economic History of Europe, Vol. VII: The Industrial Economies, Capital, Labour, and Enterprise* (Cambridge, 1978), 482.

[12] These figures are from John Pencavel, "Work Effort, On-The-Job Screening and Alternative Methods of Remuneration, " in Ronald G. Ehrenberg, ed., *Research in Labor Economics*, Vol. 1 (Grenwich, Connecticut, 1979), 225-57.

exist between the parties is that multiple wage and employment practices become standardized.[13] Once standardized, payment schemes are difficult to alter, if not adjust to. This arises because labor markets function more efficiently if terms and categories are standardized into a few recognizable packages. It also arises because the evolution of contractual forms exhibits strongly self-reinforcing learning processes on both sides of the market. The process of standardization is important in its own right. But having said this, the type or outcome of standardization must be considered too because it has ramifications for how firms and workers adapt to the process itself. Past choices impact on future decisions. In Lancashire the outcome of standardization - the wage lists - was rooted in a particular work organization. It was difficult for the industry to switch to alternative types of technology, like ring-spinning, that depended upon on a different organization. The alternative technologies demanded readjustment and relearning on the part of both workers and firms. The relevant question that needs to be addressed, therefore, is why some set of rules are chosen as opposed to another.

This paper is organized in five sections. The first section considers the general piece rate problem. The second section examines how regional lists were introduced to deter workers' propensity to restrict output and firms' drive to cut rates. Section three describes how firms and workers adapted to lists. Section four examines how firms and workers enforced these agreements in the face of competitive pressures. The conclusion summarizes differences between the Lancashire and Fall River wage lists.

The Piece Rate Problem: Lancashire and New England

The first generation of workers did not enter the factories of Lancashire ill-prepared. To meet the increasing demands of merchants or putter-outers, workers in the pre-factory stage had developed standards of a fair wage for a fair day's work.[14] When threatened with a piece rate cut, outdoor workers would respond by embezzling or producing shoddy material. The first generation of workers brought the notion of a fair wage with them into the new factories, despite attempts of factory owners to extirpate these habits by using excessive discipline and threatening male workers with replacement by women and children. Inside the factory it was common to find workers

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[13] See Gavin Wright, "Labor History and Labor Economics," in Alexander J. Field, ed., *The Future of Economic History* (Boston, 1987), 313-48.

[14] For a recent statement on norms or standards of effort during protoindustrialization, see Adrian Randall, *Before the Luddites: Custom, Community and Machinery in the English Woollen Industry 1776-1809* (Cambridge, 1991); earlier statements are John Rule, *The Experience of Labour in Eighteenth-Century English Industry* (New York, 1981); Sidney Pollard, *The Genesis of Modern Management* (London, 1965).

responding to rate cuts by withholding effort.[15] From firms' perspective output restriction was 'shirking', while in workers' view it was a means to protect the standard norm, the fair wage.

The discipline problems of recruiting and training the first factory workers are legendary. Less well understood are how and why the focus of participants became concentrated on the method of pay itself. During the rapid social and economic change of the industrial revolution cotton spinners wanted to exercise control over the relation between effort and pay and this meant attempting to preserve the standard rates they had brought with them into the factories. "If we quietly succumbed to this [piece rate] reduction," a Manchester operative declared in the mid 1850s, "other reductions would follow... until we reached the utmost limit of bare existence."[16] The standard rate was the centerpiece of their demand for a fair wage. It gave workers some protection that as they aged they would not have to work harder to maintain their levels of income; it also regulated the degree of competition between firms by fixing labor costs which in spinners' view protected them against technological unemployment. Indeed, as evidenced by their defense of piece work, textile operatives, like pottery workers and coal miners, recognized that standardizing rates translated into higher earnings because it allowed them to share in the benefits of technical growth and higher levels of productivity, or what I will refer to as the 'surplus.'

At the outset of the factory period firms were reluctant to establish a standard rate. New firms were rapidly entering the market and ideas and technologies diffused rapidly. Moreover, firms had made no commitments to their workers with respect to lengthy attachments; indeed in the early stages of the industrial revolution firms appear to have pursued actively a policy of high turnover that operated as a discipline device to get more effort output. In this environment, firms cut piece rates.

Conditions in Fall River between 1850 and 1875 or so were similar. Self-acting spinning on a large scale came to New England in the 1840s. Technical and organizational change was rapid. In response, the first generation of mule spinners, many of whom had come form Lancashire and had been engaged in both formal and informal activity in preserving standard rates of pay, fought against piece rate cuts.

Figure 1 describes the piece rate problem in the early factories.[17] Consider that earnings of spinners had been increasing for some time and it was uncertain

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[15] Michael Huberman, "Industrial Relations and the Industrial Revolution," *Business History Review* 65 (1991), 345-79.

[16] Cited in Neville Kirk, *The Growth of Working Class Reformism in Mid-Victorian England* (Champaign, 1985), 253.

[17] The model is due to David Kreps. My presentation relies on Gary J. Miller, *The Political Economy of Hierarchy* (Cambridge, 1992), 111-15. On the failure of commitment, see Robert Gibbons, "Piece Rate Incentive Schemes," *Journal of Labor Economics* 5 (1987), 413-29.

whether firms would cut piece rates. Spinners in this environment had two initial options: trust their employers that they would not cut rates of pay and in return give full effort; or mistrust and restrict output. Employers, in turn, had two possible responses: violate the trust of their workers and cut piece rates; or honor their trust. There were as a result three possible outcomes. **RENEGE** corresponded to the outcome where firms cut piece rates in face of workers giving full effort. **COMMITMENT** corresponded to the outcome where firms kept piece rates constant. Finally, at **RESTRICT** workers initially reduced effort.

Spinners obviously preferred **COMMITMENT**. They would keep higher earnings at the same piece rate, the standard rate. On the other hand, employers had the incentive to violate the spinner's trust and **RENEGE**. Knowing this spinners would reduce effort levels and **RESTRICT** was the result. This scenario made the parties worse off since both workers and firms could have done better at **COMMITMENT,** where firms would have at least gained from the full effort of their spinners.[18] In others words, although inferior from firms' perspective, **COMMITMENT** did provide them with a greater share of the surplus than available at **RESTRICT**. The problem is that **COMMITMENT** was difficult to achieve. Faced by the threat of new enterprises setting up with the latest vintage of technology firms had the incentive to bust the piece rate. Herein lies the failure of most piece rate schemes.

Commitment was not improbable, however. It was more often to emerge in very long-run organizations, where each side of the market had confidence through the experience of rounds of negotiations that the other side was trustful. Firms needed to secure a reputation that they would uphold the fair wage; workers needed to develop the reputation that they would resist from withdrawing effort. Only if commitments were kept repeatedly could cooperation have evolved. "Negotiations," according to the leading game theorist Robert Wilson, "are the evolution of the parties' reputations."[19]

In this context fixing piece rates can be seen as a "tit-for-tat" strategy in a coordination game. A tit-for-tat strategy in a multiperiod game is defined as playing the cooperative alternative, **COMMITMENT** in the first play of the game and mimicking the other player's response in subsequent moves. Thus, in the first round employers agree not to cut piece rates, as long as workers agree to provide high levels of effort; but if employers break this commitment then workers will respond by defecting, that is choosing **RESTRICT**. The cooperative outcome will result if and

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[18] Spinners preferred rankings are: commitment, restrict, renege. Firms preferred rankings are: renege, commitment, restrict.

[19] Robert Wilson, "Reputations in Games and Markets," in Alvin E. Roth, ed., *Game Theoretic Models of Bargaining* (Cambridge, 1985), 59. Cooperation is an en equilibrium position in a repeated game if the time horizon is long and the discount rate is low.

only if each party perceives a long-term commitment; if the game is suspected to end each side would take the short-term gain of defecting.

For commitments to be credible reputations need to be enforced or monitored. Third parties like the courts could act to enforce agreements, but this is highly improbable. It has proven to be difficult to write labor contracts specifying piece rates for specific jobs for specific states of nature. As an alternative, firms and workers could themselves monitor agreements and punish defectors. This proved to be difficult in New England where not only was technical and organizational change rapid, but mobility of workers was great and community enforcement mechanisms failed to take root. In Lancashire, by contrast, mobility tapered off at midcentury at the time many of the lists were introduced. Because the industry was segmented into distinct regions, which the lists helped to reinforce, firms and workers could better monitor and enforce their agreements. Herein lies the success of the Lancashire wage lists.

Regions and Lists

The Bolton List

Beginning with the introduction of Crompton's mule, Bolton was a center of the fine-spinning trade in Lancashire. Unlike Manchester where there was a wide variety of work done, firms in Bolton spun medium and high counts of yarn almost exclusively. With the expansion of fine spinning Bolton grew rapidly in the first decades of the century. The number of spindles per worker in the town, relative to coarse spinning Oldham, is evidence of the pace of technical change (Table 1). By 1811 the town had 33 mills which spun fine yarn and the average mill had about 150 workers. After 1825 markets stagnated and there was little new capacity added in fine spinning; still, as late as 1841 the average fine-spinning mill in Lancashire employed about 200 workers and was nearly twice as large the average coarse-spinning establishment.

On long mules like those used in fine-spinning Bolton, spinners were more likely to restrict output and get away with it. Women and young men could spin on small mules and on self-actors, but long mules were controlled by men. They required greater physical strength to operate and more supervision of piecers, tasks contemporaries believed and espoused that men performed better than women.[20] Without the threat of replacement, male spinners were more willing to take the risk of being caught 'shirking'. If they faced short unemployment spells they could rely on the

[20] For a discussion and bibliography of the role of gender in spinning, see Lazonick, *Competitive Advantage*; Sonya O. Rose, *Limited Livelihoods: Gender and Class in Nineteenth Century England* (Berkeley, 1992).

poor law for assistance. Finally, unionization which accompanied the lengthening of mules and the domination of spinning by men enhanced the ability of spinners to organize work to rule campaigns, and further reduced firms' ability to deter output restriction.

To put an end to the restriction of output Bolton workers and firms negotiated a wage list. The first detailed study of Lancashire lists, the report of the British Association for the Advancement of Science declared that the "first list known in the spinning trade was that adopted at Preston in 1859," and that the remaining major lists were put in place in the next twenty-five years.[21] This view has left the impression, repeated in the literature, that the origins of the major lists are found in the mid-Victorian boom and that they were an outgrowth of trade union consolidation.[22] However, S. J. Chapman speculated that all lists were not introduced at the same time.[23] He wrote that the Bolton list was "said to date back to 1813, but corroborative evidence is lacking."

I have located the list Chapman referred to. It is clearly dated 1813 and appears to have been a general and not a private or mill one.[24] The list assured spinners of receiving the highest wage for spinning the district's specialty. A Bolton employer remarked that firms in the town paid by a list "so that our prices might be generally known as being higher than in other towns."[25] The list stipulated prices paid per lb. of yarn spun and to account for the longer time required to spin finer yarns, prices paid increased with count spun. It was a pure piece rate list with no adjustments for either the length or speed of the mule.

At this stage cooperation among firms, and between workers and firms, was short-lived. Technical change in the fine-spinning sector in the early decades of the century was rapid and put downward pressure on piece rates.[26] Led by large firms like M'Connel and Kennedy of Manchester the sector was in the forefront of designing and implementing changes to the common-mule and applying artificial power to

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[21] British Association for the Advancement of Science, *On the Regulation of Wages by Means of Lists in the Cotton Industry* (Manchester, 1887), 11.

[22] Patrick Joyce, *Work, Society and Politics: The Culture of the Factory in Later Victorian England* (London, 1982).

[23] S. J. Chapman, *The Lancashire Cotton Industry* (Manchester, 1904), 593-94.

[24] A General List of Prices of Spinning, zz/220, Bolton Public Library, Bolton.

[25] Report from the Select Committee on Artisans and Machinery," *Parliamentary Papers*, 1824 V (51), 556-57.

[26] Technical progress was more rapid in fine than in coarse spinning because mule speeds were slower and the weight of the carriage significantly less.

production. The average number of spindles per mule in fine spinning increased from roughly 144 spindles in 1790, to 600 in the 1820s, and to 1200 by the late 1830s. Firms and workers disputed the amount of effort required to spin on the new and longer mules.[27] To preserve the standard or normal relation between effort and pay, workers insisted that piece rates be the same on all mules because of the added physical effort required to spin on longer ones; but firms were adamant that if rates were not cut or discounted on longer mules, workers would capture all the gains of technical change and there would be little incentive for further investment. Pressured by the entry of new firms, employers sought changes to the 1813 list.

A protracted and bitter strike ensued in Bolton between 1822 and 1823, and in the end firms succeeded in introducing a list with discounting.[28] Table 2 reproduces the Manchester list of 1829 which was based on the new Bolton list of 1823.[29] The first column gives the count or fineness of yarn spun; the first row the number of spindles per mule. The prices for spinning a pound of yarn increased with fineness to compensate for the increased time of production, but prices paid decreased with size of mule. Although the masters appeared to have got their way, the strike was a turning point in industrial relations in Bolton, as it was in Manchester in 1829. During the course of the dispute and its aftermath employers complained of the difficulty they had in finding qualified male spinners to replace recalcitrant workers.[30] They recognized that retaining the lists and paying workers steady and high rates of pay would reduce tensions between the parties. For workers the 1823 list, even with the introduction of discounting, protected them from the unremunerated intensification of their labor. For a mule of a given size, rates of pay per pound of output were fixed and spinners would capture the gains if employers attempted to speed up work or extract more effort. It is in this sense that the lists codified a fixed rate of pay. Note as well that because of constant piece rates, spinners would capture much of the rewards of operating mules with more than 468 spindles.

After the 1823 dispute cooperation in Bolton was more permanent. In his survey of methods of pay in the textile industry in 1833, Factory Inspector Cowell noted the existence of the list; later in the decade, Preston spinners went out on strike

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[27] For treatments of these issues, see R. G. Kirby and A.E. Musson, *The Voice of the People: John Doherty, Trade Unionist, Radical and Factory Reformer* (Manchester, 1975), 28; Cohen, *American Management*, 83-87.

[28] The most thorough study of the early disputes is John Mason, "Mule Spinners and the Early Federations," in Alan Fowler and Terry Wyke, eds., *The Barefoot Aristocrats: A History of the Amalgamated Association of Operative Cotton Spinners* (Littleborough, Lancashire, 1987) 23-24.

[29] The 1813 list is in poor condition and cannot be reproduced.

[30] *Parliamentary Papers*, 1824 V (51), 559.

for the Bolton list of prices.[31] The lists negotiated did not tamper with the structure of the lists as found in Table 2. With the absence of a speed clause, spinners received the entire gains of their increased effort. Moreover, firms did not reap the benefits of new investments. Because the lists fixed prices per pound of yarn spun, this meant that firms spinning on newer technologies had the same labor costs as firms using older vintages. Workers across firms would thus have earned different wages for the same effort, thus undermining their demand for a standard and unchanging relation between effort and pay. However, the variance in earnings and labor costs among firms was not significant. By mid-century most Bolton firms used the same vintage of machinery as the entry of new firms tapered off.

The Oldham list

The spread of factory industry occurred later in Oldham than in Bolton, although the two towns are no more than 50 miles apart. Until mid-century there were a large number of firms in Oldham that rented or shared space and power in a larger mill. The "room and turning system" maintained the small firm as the typical unit of production. D. A. Farnie, the leading modern historian of the cotton textile industry, wrote that the system "accentuated the degree of competition, and increased the mortality rate among factory masters," and again in contrast with Bolton, prevented "the family firm from establishing an hereditary monopoly of local industry under a separate caste of employers."[32] As late at 1841 the average coarse mill employed only 100 workers. Moreover, into the 1860s, Oldham's population was less stable; between 1821 and 1861 its rate of population growth was more than 20 per cent greater than Bolton's.[33] With a greater inflow of workers, Oldham firms had little reason to develop long-term relations with their workers and maintain reputations. Instead they cut piece rates.

While fine-spinning technology had initially developed quickly, there were fewer changes in coarse spinning until the mid 1820s. As a result employers encountered little difficulty in setting rates of pay. The small size of firms also deterred output restriction because of lower supervision costs. Moreover, the relatively higher proportion of women and young male spinners in the sector dampened workers' ability to reduce effort and output. In the early decades of the century a good deal of coarse warp yarn was spun on throstles. Throstle spinners, who were mainly teen-aged girls

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[31] "Supplementary Report on the Employment of Children in Factories," *Parliamentary Papers*, 1834 XIX (167); Henry Ashworth, *An Inquiry into the Origins, Progress and Results of the Strike of the Operative Cotton Spinners of Preston* (Manchester, 1837).

[32] Douglas A. Farnie, *The English Cotton Industry and the World Market, 1815-96* (Oxford, 1979), 247-51.

[33] Calculated from Joyce, *Work, Society*, 104.

and young women, were unskilled operatives and they neither organized nor supervised production. Young boys or women also spun coarse weft yarn on small common-mules. And in the initial period after the introduction of Roberts' self-actor in 1825, a larger proportion of younger people and women were employed as spinners or minders, as they were referred to on the new technology.[34] Although the vast majority of self-actor minders were adult males, the replacement of men, or even the threat of dismissal, was a potent strategy to deter them from reducing effort levels. Finally, the limited skill demands and the availability of women and children made it difficult for male spinners in coarse spinning to organize, at least initially, a strong union presence to challenge employers' threats of rate cuts or replacement.

The growth of large and permanent firms in Oldham commenced with the wide-scale adoption of the self-actor after mid-century. Beginning in 1867, the diffusion of the self-actor ushered in a decade of unprecedented expansion of spindleage that undermined the position of the small employer, in so far as it entailed an enlargement in the size of mill. The emergence of joint-stock companies made it possible for smaller firms to take advantage of the perfected self-actor and respond to the shortage of room and turning space. The expansion was rapid. During the boom of 1873-75, which was the greatest in Oldham's history, seventy limiteds were created. Small firms evolved, and as shown in Table 1, by the mid-1880s the average size of Oldham and Bolton firms were almost identical.

The immediate cause of the introduction of the Oldham list was a lengthy strike in 1872 involving about 200 mills and 20,000 operatives.[35] The dispute posed a threat to the viability of the new limited liability companies since many employers lost spinners to firms in neighboring towns. As a sign of their commitment, firms offered workers a permanent list in 1872 which paid spinners in Oldham the highest wages for spinning coarse counts in all of Lancashire.[36]

There were later revisions to the list but its makeup remained the same. It calculated how much yarn could be normally produced on mules of different speeds and lengths. To find the piece rate, normal production on a given mule was divided into the standard weekly wage each spinner was assured of. Figure 2 summarizes the main differences between the Bolton and Oldham lists. The former was a pure piece rate system; the latter included a time component that stipulated a standard weekly wage. Unlike the Bolton list, the Oldham list thus made for equal earnings, but

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[34] Lazonick, *Competitive Advantage*.

[35] Andrew Bullen, "The Founding of the Amalgamation," in Fowler and Wyke, eds., *Barefoot Aristocrats*, 68.

[36] G. H. Wood, *The History of Wages in the Cotton Trade during the Past Hundred Years* (Manchester, 1910), 116.

unequal labor costs per lb. of yarn spun. Later variants of the Oldham list also included a speed clause that split the gains in output between firms and workers.[37]

Adjustments to the Lists

For all of Lancashire the Preston strike of 1853-54 was a watershed in the development of industrial relations.[38] From workers' perspective the issue at Preston, as in many earlier disputes, was firms' reputation and their failure to commit to reversing a wage cut. Citing poor trade prospects, Preston employers claimed they could not restore piece rates as they had promised earlier; instead they busted wages. A lengthy and bitter battle ensued and in the end workers lost their claim.

The experience at Preston highlighted to both parties the costs of breaking commitments. The outcome was incompatible with eliciting high and steady levels of effort because firms that tried to force a wage cut found it difficult to recruit high quality workers in throughout the 1850s.[39] An alternative arrangement was for capital and labor to agree on a mutually beneficial division of the surplus, generated by keeping the piece rate fixed. As evidenced by the spread of regional lists, commitments were generally kept after the Preston dispute. In Preston itself, in 1859, a list was introduced that brought wages of their minders up to the levels of other districts. Although it was a coarse spinning district, its list was modeled after the Bolton type. Other lists in Blackburn, Ashton, Hyde, Burnley, Bury, and Stockport were also modeled after the Bolton list.

The commitment solution stuck because firms and workers adjusted to the lists and maintained their share of the surplus. By 1875 the lists became the centerpiece of industrial relations. "Look after the lists, and wages will look after themselves" was the spinners' maxim.[40] For spinners or minders the lists consolidated the organization of production in which they recruited, supervised, and paid their

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[37] The nature of technical change in Oldham contributes to explaining why its list differed from that of Bolton. Most of the self-actors used in Oldham were produced by the local firm of Platt Bros. and the standardization across firms made it easier for managers to acquire information on how much output could be produced in a given time. Douglas A. Farnie, "The Emergence of Victorian Oldham as the Centre of the Cotton Spinning Industry," *Bulletin of the Saddleworth Historical Society* 12 (1982), 41-54. The time component of the list would only have been practical if firms had some notion of what could be produced in a given period. Eugene Fama, "Time Salary and Incentive Payoffs in Labor Contracts," *Journal of Labor Economics* 9 (1991), 25-54.

[38] The standard work on the Preston strike is H. I. Dutton, and J. E. King. *Ten Percent and No Surrender: The Preston Strike, 1853-54* (Cambridge, 1981).

[39] Dutton and King, *Ten Percent*, 45, 179.

[40] Cited in Rowe, *Wages in Practice*, 164.

piecers. In Bolton, where the available supply of piecers was greatest, the list stipulated the gross wages of spinners who were left to strike a bargain with their piecers. Although the Oldham list in principle gave piecers a proportion of the minders' standard earnings, they were in effect paid by the time.[41] Thus, the two major district lists motivated spinners to drive their assistants, because they did not necessarily distribute equally among the members of the work team the gains of its increased effort.

Along with preserving the work team, the lists regularized adjustments to piece rates, thereby assuring spinners that any rate cut would be restored.[42] During the onset of a trade decline, after a period of short-hour working, it was common practice to cut rates by 5 per cent.[43] The standard relation between effort and pay was not tampered with and with the onset of recovery, the rate cut would be returned. Thomas Ashton, head of the Oldham spinners, best described the pattern of negotiations. "The best plan is for employers and employed to agree upon a rule of wages as a standard, and let the general state of trade afterwards govern such rate of wages up or down, always allowing reasonable profits for capital."[44] There were occurrences of employers cutting rates by 5 per cent in succession, but the Brooklands Agreement of 1893, which was called by a leading employer "the most complete treaty between capital and labor that has ever been framed," routinized these adjustments to just one change in

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[41] Webb Collection, vol. XCIII, no. 3, London School of Economics, London. The revised Oldham list of 1876 specified that piecers were prohibited from sharing in payments to minders for the extra work involved in such things as tubing, putting extra twist into the yarn, and faster carriage speeds, even though the piecers expended as much, if not more, of the extra labor power.

[42] On industrial relations and the lists after 1870, see J. H. Porter, "Industrial Peace in the Cotton Trade, 1875-1913," *Yorkshire Bulletin of Economic and Social Research* 19 (1967), 49-62.

[43] On short-hour working, see Michael Huberman, "Some Early Evidence of Worksharing," *Business History* (forthcoming).

[44] Quoted in Cohen, *American Management*, 86.

any year of no more than 5 percent.[45] The Agreement also set up an elaborate grievance procedure to settle disputes.

To a limited extent firms adjusted to the lists by changing material inputs. In response to the lists' makeup there was a tendency among coarse-spinning firms to use inferior and cheaper cotton. Inferior cotton produced more end breakages and generated more work for the spinning team. The strategy would lower net costs as long as the minder could drive his assistants harder to mend the additional broken threads. This approach had its limits, as evidenced by the frequent and bitter bad spinning disputes. These disputes were finally resolved, albeit unsatisfactorily, in the Brooklands Agreement. In fine spinning firms could not alter the cotton used, but there is evidence of firms trying to reduce costs by paying for lower counts of yarn than were actually spun.[46]

Extending the length of spinning mules and improving the timing and speed of the spinning mule were the principal means by which employers adjusted to the lists. Steady improvements in the self-actor increased the ratio of spinners to spindles and offset the productivity losses associated with inferior cotton. Between 1876 and 1907, spindleage in this sector grew by 105 percent. The increase in manning ratios was an adaptive response to the high wages paid to spinners. Because the nature of the list in coarse spinning meant that workers and firms shared the benefits of the new investments, unit costs as specified by the Oldham list fell by 15 percent during the same period.[47] Recall that, in contrast, the makeup of the Bolton list deterred *in*

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[45] The quote is from Porter, "Industrial Peace," 49. The first history of the lists arrived at a similar conclusion:

> "The lists have not succeeded in removing all probability of dispute between employer and employed. They have, it is true, introduced uniformity into the payment of wages in the cotton trade, *caused wages to be payable on definite and known principles* [my emphasis], adjusted the wages of different classes of spinners, and defined strictly the duties of the operative; but they do not make wages vary either with the varying cost of the raw material or the varying prices realized for the finished product. The standard, in other words, implies a given condition of trade. A changed condition, e.g., a rise or fall in the price of yarn, when fully established results in a percentage being added to or taken from the wages payable. The method of determining the occasion and the amount of alteration is determined by negotiation between the association of employers and the association of spinners."

Report on the Regulation of Wages, 12. For similar statements, see Webbs, vol. XXXIV, 171-72; and sources quoted by Cohen, *American Management*, 86.

[46] Minute Books of the Operative Cotton Spinners Provincial Association, Bolton District, Half Year Ending, June 7, 1890, 57.

[47] "[I]t cannot be altogether fortuitous that the districts most favorable to the employer [like Oldham] were increasing in relative importance throughout the period, whilst other districts with unfavorable lists were falling back." Jewkes and Gray, *Wages and Labour*, 115. The evidence on spindles and unit costs are taken from pages 42 and 48.

principle technical change. The list had no speed clause and piece rates in the period after 1860 or so remained constant on mules over 806 twist spindles; as result, unit costs as determined by the fine-spinning list fell slightly, by only 2 percent between 1876 and 1907. In spite of these obvious drawbacks investment in fine spinning increased in the late nineteenth century, although not at the rate witnessed in coarse spinning. The number of spindles in Bolton rose by 75 percent between 1882 and 1913 and by the first decade of the twentieth century the average mule carried 1,100 spindles. Firms continued investment was based on their expectation that increased worker effort on these new longer mules would cover the rise in fixed expenses.

Thus both parties adjusted to the fixed piece as set by the lists: workers raised their effort; firms made continuing investments in the same technology. Average real earnings of spinners from 1870 to 1913 increased by about 1.5 percent per annum matching the increase in productivity of 1.27 percent.[48] Note that in the period prior to 1850 wages and productivity did not move together. From 1830 to 1850 productivity increased by about 2.0 percent per annum, but earnings stagnated, evidence that firms were cutting rates of pay when they had the opportunity.

Returning to the period after 1850, G. H. Wood, an early statistician of the cotton trade, attempted decomposing the relative contributions of effort and technical change to the rise in earnings. Average earnings of operatives rose by 69 percent between 1860 and 1906, and Wood attributed about 7 percent of this gain to increased rates of pay and about 13 percent due to the employment of relatively more adults. The remaining 49 percent, he concluded, was the result of "increased efficiency of operatives and machine."[49] Because we have estimates of the productivity change in coarse spinning, the residual can be broken down further. Jewkes and Gray found that over the same period the number of spindles per mule and its speed increased by about 44 percent, but since workers captured only half of the gain, this means that [49 percent - (44/2) percent =] 27 percent of the rise in average spinners' earnings in Lancashire can be attributed to the greater efficiency of the operative. Using Wood's procedure, increased effort explains between 12 and 15 percent of the rise in spinners'

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[48] Lazonick, *Competitive Advantage*, 158; Wood, *History of Wages*, 54. All figures are for coarse spinning which represents the median type of yarn spun. For the period before 1850, productivity estimates from Andrew Ure, *The Philosophy of Manufacturers* (London, 1835).

[49] The magnitude of the increase of effort appears large, but it is consistent with the annual improvement in labor quality for the entire British economy Matthews and his collaborators found as a result of legal changes to the work week after mid-century. Wood, *History of Wages*, 139; R. C. O. Matthews, C. H. Feinstein and J. C. Odling-Smee, *British Economic Growth 1856-1973* Oxford: Clarendon Press, 1982), 104, 503. Other estimates of increased effort or "speed-up" range from 15 - 20 percent between 1865 and 1885. Lazonick, *Competitive Advantage*, 121; Cohen, *American Management*, 88.

earnings in Oldham and Bolton.[50] Samuel Andrew, the Secretary of the Employers Association of Oldham, summarized the interplay between machinery and labor efficiency:

> We have at this moment the most capable labor in the world. It is born and brought up well suited and disciplined in to its work; under its wage-lists, with the present improved machinery we can depend upon it fulfilling its duty with the accuracy of clockwork.[51]

It needs to be reinforced that the parties abided by their commitments on a *given* technology, mule-spinning. To draw up a new set of arrangements on a later technology, like ring-spinning, would have entailed high costs in developing new reputations; it is also difficult to estimate the enforcement costs of the new arrangements.[52] Both parties had an incentive to keep arrangements intact and this meant adapting to structure or making incremental changes, rather than scrapping it entirely. This point was made by Jewkes and Gray in their study of industrial relations in cotton textiles during the inter-war year. The lists, they wrote "gradually accumulated local peculiarities which in themselves constitute[d] the greatest obstacles" for change.[53] Workers were willing to expend more effort and firms continued to make improvements to their mules, even when there existed alternative technologies that offered the possibility of lower labor costs.

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[50] Jewkes and Gray, *Wages and Labour*, 205. After correcting for the decline in hours worked from 60 to 56.5 in 1875, minders' pay in Oldham increased by 32 percent between 1870 and 1900. The piece rate as set by the list increased by 5 percent in the period, and workers' share from productivity gains amounted to about 15 percent, leaving 12 percent of the increase in earnings to be accounted for by increased effort. Conditions were different in Bolton: earnings of spinners rose by about 29 percent after making an adjustment for hours; the list was unaltered; and technical change was slower than in Oldham. Using 15 percent as an upperbound estimate of the contribution of technical improvements, increased effort was responsible for at least 14 percent of the rise in earnings in Bolton. Note that the use of inferior cotton required even greater effort to maintain levels of earnings. Thus, at least for coarse spinning, my calculation underestimates the gross contribution of effort.

[51] Cited in Gustav von Schulze-Gaevernitz, *The Cotton Trade in England and on the Continent* (London, 1895), 130.

[52] Alexander J. Field, "Microeconomics, Norms, and Rationality," *Economic Development and Cultural Change* 32 (July 1984): 683-711.

[53] Jewkes and Gray, *Wages and Labour*, 103.

Enforcing the Lists

In the 1870s nine lists were in operation, but by the 1890s the Bolton and Oldham lists regulated the wages of about 75 per cent of the cotton spinners of Lancashire and Cheshire, and by the 1930s, about 85 percent of the total.[54] Although the minor lists disappeared, the two major lists retained their viability because they continued to be enforced as regional lists.

The Bolton and Oldham wage lists evolved into the two dominant district lists despite the makeup of the lists themselves. The lists' structure implied that it was cheaper to use the Bolton list to spin coarse yarn, and that the opposite held true for spinning fine yarn using the Oldham list. This is remarkable given the close distances between towns in Lancashire and the high mobility of capital, and the obvious gains for some individual firms and workers to break the district lists. There is evidence of mills attempting to take advantage of the differentials. Jewkes and Gray noted these differentials as well: "[T]he observable differences have no real relation to technical conditions, but are the outcome of chance, or the unforseen offspring of some muddled industrial struggle."[55] As for why differentials persisted in the face of competition, Jewkes and Gray asserted it was due to "sanction and prestige." This begs the question as to the mechanisms used by firms and workers to enforce regional standards.

An episode in Darwen, a coarse spinning town, illustrates the fine balance between private and social gains. In the mid-1890s with the market for fine yarn expanding, a mill in the town began spinning fine counts of yarn using the Oldham list.[56] Workers demanded to be paid the higher wages set by the Bolton list and a dispute ensued. With the intention of preserving the Oldham list, the vast majority of firms in the region supported the workers' demand and in the end the maverick firm resumed spinning coarse yarn.

Enforcement was rooted in the community networks of Lancashire towns. Patrick Joyce has described in detail the bonds that tied Lancashire firms and workers within and outside the factory. Where population movements stabilized, and this occurred generally after 1850, he wrote, a sense of community developed. "At the center of this sense was the neighborhood, and very near the heart of the neighborhood feeling the factory "[57] In these type of communities both parties could monitor each other closely because their lives intersected each other not only in the factory, but also

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[54] *Ibid.*, 53.

[55] *Ibid.*, 103.

[56] *Cotton Factory Times* 25 May 1894.

[57] Joyce, *Work, Society*, 110; idem., *Visions of the People: Industrial England and the Question of Class, 1848-1914* (Cambridge, 1991).

in church, at the mechanic institute, or at the benevolent society. Political preferences also crossed traditional 'class' lines. In this manner the association of workers and firms developed its own rules of what was just and fair. Those who did not fit in moved elsewhere.[58]

The use of rules like those in Lancashire is a common feature of labor markets. Robert Solow has argued that codes or norms are necessary wherever there exists conflict between private and social gains.[59] In time, however, norms of economic behavior become standardized because both workers and firms act according to what is the right thing, rather than because they have reckoned precisely all the consequences. Each principal fears violating the standard for fear of being ostracized, while those who do the ostracizing do so because they fear that if they do not ostracize those who violate the norms of behavior, they themselves will be ostracized or suffer the penalty of social censure.

The combined efforts of workers and firms to preserve the district lists can be traced as far back as the late 1820s. Large employers using longer spinning mules helped sponsor trade union attempts to organize outlying areas and impose the standard rate of pay on smaller concerns that had initiated rounds of wage and price cuts and protracted and costly labor disputes. In the 1830s spinners in Bolton organized in a comparable fashion financial assistance to strikers in neighboring regions to "ensure the payment of customary rates."[60] Similar evidence can be found on the spread of the Oldham list.[61] The lists' regional coverage gave workers added insurance that the standard relation between effort and pay was protected. As for employers, the lists compelled them to organize associations to administer and undertake collective bargaining. Once organized, employers took the initiative to use the lists as vehicles to regulate competition and reduce uncertainties in labor and product markets.[62]

The Lancashire press was the principal means of self-enforcement. Beginning as early as the 1820s, both operatives' and employers' newspapers listed

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[58] John K. Walton, *Lancashire: A Social History, 1558-1939* (Manchester, 1987), 249.

[59] Robert M. Solow, *The Labor Market as a Social Institution* (Oxford, 1990).

[60] *Bolton Chronicle* 15 Oct., 29 Oct. 1836; Webb Collection, vol. XXXIV, 56, 148-50, 231.

[61] Webb Collection, vol. XXXVI, 54.

[62] Arthur McIvor, "Cotton Employers Organizations and Labour Relations, 1890-1939," in J. A. Jowitt, and A. J. McIvor, eds., *Employers and Labour in the English Textile Industries, 1850-1939*, (London, 1988), 7.

names of firms upholding and those breaking agreements about piece rates.[63] In May 1841 a group of spinners and manufacturers placed an advertisement in the *Manchester Guardian* that listed employers who were working short-time because it will 'bring relief to the employers by shedding stock and to the operatives by preventing a further reduction in wages'.[64] Memories were long in Lancashire. A report for Bolton during the 1847-48 recession identified one firm, Knowles, that had been known to be a rate buster for upwards of thirty five years and that had now begun to work short-time and abstain from cutting rates.[65] After 1870 or so similar forms of sanctioning were practiced by the *Cotton Factory Times*.[66]

The regional nature of the lists and spinning industry were important determinants of declining enforcement costs. The lists contributed to the regionalization of the industry because they ensured that workers in the each region received the highest wages for spinning their speciality of yarn. Thus in Bolton spinners earned the highest earnings in Lancashire for spinning fine yarn; similarly for coarse spinners in Oldham. But growing regionalization also contributed to preserving the lists because specialization brought with it externalities, such as marketing and distributing networks. Regionalization also meant the creation of a local labor force skilled in a particular type of product, whether it was fine or coarse yarn. The feedback mechanism between regional specialization and the lists increased the cost to any firm (or worker) who wanted to move between regions to take advantage of any wage differentials. Thus, In Lancashire, to invert Adam Smith, the division of labor depended on the limited — that is, regional — extent of its market.

Conclusion: When Did Lists Work?

Between the Civil War and World War I, New England and Lancashire mule-spinning firms used the same machine technologies and had access to workers of the same ethnic background with equivalent skills. But permanent lists failed to take hold in New England and employers cut piece rates throughout the period. Cohen attributed these divergent paths to the ability of Fall River employers to turn back

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[63] For examples, see *Stockport Advertisor* 20 July 1826; *Voice of the People* 24 Feb. 1831; *Manchester Guardian* 16 Aug.1839; *Ten Hours Advocate* 13 Mar. 1847.

[64] *Manchester Guardian* 15 May 1841; see also 28 April 1841.

[65] *Manchester Guardian* 13 Oct. 1847.

[66] For examples, see Joyce, *Visions of the People*.

union demands.[67] This paper has proposed an alternative explanation based on a simple model of the piece rate bargain. Workers can either trust or mistrust their employers with regard to keeping piece rates constant. Trust depends on firms' credibility in keeping fixed piece rates, but commitments of this type need to be monitored and enforced. In New England trust was undermined because there was little reason for firms that had invested in new machinery and for highly mobile workers to design institutions that would preserve commitments. Competitive forces that led to rate busting were left unchecked, and, unlike Lancashire, ring spinning was adopted smoothly by Fall River firms.

The success of wage lists in Lancashire lay in the ability of firms and workers to keep at bay the forces of competition. Firms and workers opted for a package of fixed piece rates on a given technology and low turnover. The regional pattern of production in Lancashire which at once was the cause of the development of district lists and the effect of the lists themselves, reduced enforcement costs. In raising productivity and lowering firms unit fixed costs, the lists contributed in no small way to the success of the British textile industry into the early twentieth century. Thus the claim of many commentators in the 1920s that the high labor costs embedded in the lists impeded the diffusion of the new ring-spinning technology has merit only in the sense that benefits of standardization were so great, it made the older technology competitive for longer than would have been otherwise desirable.[68] In testament to the power of standardization the wage lists were rewritten only after World War II - long after the industry was viable.

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[67] Cohen, *American Management*, 104-15.

[68] For a classic statement see, Henry Clay, *Report on the Position of the British Cotton Industry* (London, 1931).

TABLE 1

FIRM SIZE IN BOLTON AND OLDHAM, 1811-1884

	Bolton		Oldham	
Year	Number of Firms	Workers per Firm	Number of Firms	Workers per Firm
1811	33	148	19	95
1821			113	
1835	42	195		
1841	55	217	201	116
1863				161
1884	100	194	237	184

Sources: **1811** - Crompton's survey of Lancashire textile industry reprinted in Honeyman, *Origins of Enterprise*, 182-84. **1821** - Edwin Butterworth, *Historical Sketches of Oldham* (Oldham, 1856), 31. **1835** - Longworth, *Cotton Mills of Bolton*, 31. **1841** - R.A. Sykes, "Some Aspects of Working Class Consciousness in Oldham, 1830-42," *Historical Journal*, 23 (Mar. 1980): 169. **1863** - P.P. 1864 (XXII), 590. **1884** - *Worral's The Cotton Spinners' and Manufacturers' Directory* (Oldham, 1884), 11-15, 59-67.

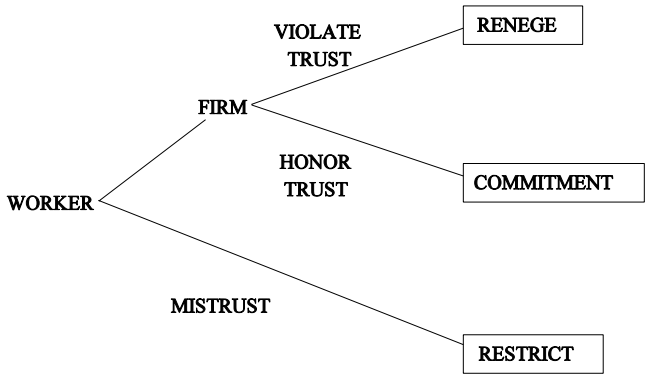


FIGURE 1

THE PIECE RATE PROBLEM.

TABLE 2

THE MANCHESTER LIST OF 1829

FACTORY COMMISSION:

The Manchester List of Prices for spinning upon Mules of different Sizes.

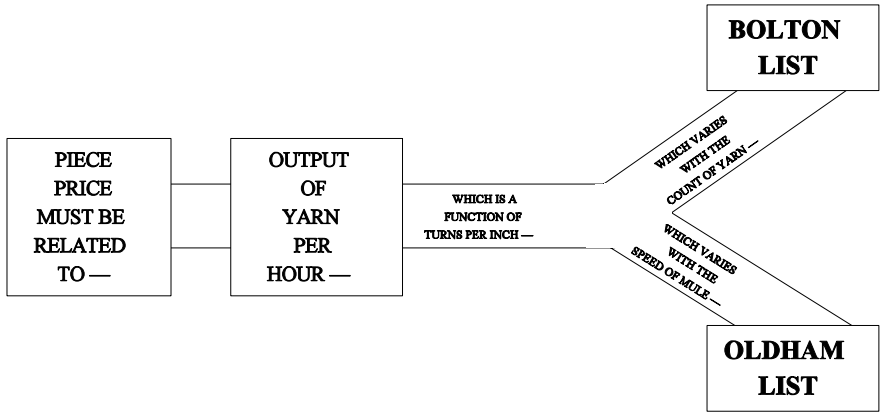
	Spindles, 300.		Spindles, 312.		Spindles, 321.		Spindles, 336.		Spindles, 348.		Spindles, 360.		Spindles, 372.		Spindles, 384.		Spindles, 396.		Spindles, 408.		Spindles, 420.		Spindles, 432.		Spindles, 444.		Spindles, 456.		Spindles, 468.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
Nº 80	0	5	0	5	0	4¾	0	4¾	0	4¾	0	4½	0	4½	0	4½	0	4½	0	4¼	0	4¼	0	4¼	0	4	0	4	0	4
— 85	0	5½	0	5½	0	5¼	0	5¼	0	5¼	0	5	0	5	0	5	0	4¾	0	4¾	0	4½	0	4½	0	4½	0	4½	0	4½
— 90	0	6	0	6	0	5¾	0	5¾	0	5¾	0	5½	0	5½	0	5½	0	5¼	0	5¼	0	5	0	5	0	5	0	5	0	5
— 95	0	6¾	0	6¾	0	6½	0	6½	0	6¼	0	6¼	0	6	0	6	0	5¾	0	5¾	0	5½	0	5½	0	5½	0	5½	0	5½
— 100	0	7½	0	7½	0	7¼	0	7¼	0	7	0	7	0	6¾	0	6¾	0	6½	0	6½	0	6¼	0	6¼	0	6¼	0	6¼	0	6¼
— 105	0	8¼	0	8¼	0	8	0	8	0	7¾	0	7¾	0	7½	0	7½	0	7¼	0	7¼	0	7	0	7	0	6¾	0	6¾	0	6¾
— 110	0	9¼	0	9¼	0	9	0	8¾	0	8¾	0	8½	0	8½	0	8¼	0	8¼	0	8	0	7¾	0	7½	0	7½	0	7½	0	7½
— 115	0	10¼	0	10¼	0	10	0	9¾	0	9¾	0	9½	0	9½	0	9¼	0	9	0	8¾	0	8¾	0	8½	0	8½	0	8½	0	8½
— 120	0	11½	0	11¼	0	11	0	11	0	10¾	0	10¾	0	10½	0	10¼	0	10	0	9¾	0	9¾	0	9½	0	9½	0	9¼	0	9¼
— 125	1	0¾	1	0½	1	0¼	1	0¼	1	0	1	0	0	11¾	0	11½	0	11¼	0	11	0	10¾	0	10½	0	10½	0	10¼	0	10¼
— 130	1	2¼	1	2	1	1¾	1	1½	1	1½	1	1¼	1	1	1	0¾	1	0½	1	0¼	1	0	0	11¾	0	11¾	0	11½	0	11½
— 135	1	3½	1	3¼	1	3	1	2¾	1	2¾	1	2½	1	2¼	1	2	1	1¾	1	1½	1	1¼	1	1	1	0¾	1	0½	1	0¼
— 140	1	5	1	4¾	1	4½	1	4¼	1	4	1	3¾	1	3½	1	3¼	1	3	1	2¾	1	2½	1	2¼	1	2	1	1¾	1	1½
— 145	1	6½	1	6¼	1	6	1	5¾	1	5¼	1	5	1	4¾	1	4½	1	4¼	1	4	1	3¾	1	3½	1	3¼	1	3	1	2¾
— 150	1	8	1	7¾	1	7½	1	7¼	1	6¾	1	6½	1	6¼	1	6	1	5¾	1	5¼	1	5	1	4¾	1	4½	1	4	1	3½
— 155	1	9½	1	9¼	1	8¾	1	8½	1	8	1	7¾	1	7½	1	7¼	1	7	1	6½	1	6¼	1	6	1	5¾	1	5½	1	5
— 160	1	11	1	10½	1	10¼	1	10	1	9½	1	9¼	1	9	1	8½	1	8¼	1	7¾	1	7½	1	7¼	1	7	1	6½	1	6
— 165	2	1	2	0¾	2	0¼	2	0	1	11½	1	11	1	10¾	1	10¼	1	10	1	9¾	1	9½	1	9	1	8¾	1	8¼	1	8
— 170	2	3¼	2	3	2	2½	2	2	2	1½	2	1	2	0¾	2	0¼	2	0	1	11¾	1	11½	1	11	1	10½	1	10	1	9½
— 175	2	6	2	5½	2	5	2	4½	2	4	2	3½	2	3¼	2	2¾	2	2¼	2	2	2	1½	2	1	2	0¾	2	0¼	2	11½
— 180	2	8¾	2	8¼	2	7	2	7¼	2	6¾	2	6¼	2	6	5¼	2	2	4¾	2	4¼	2	3¾	2	3¼	2	3	2	2½	2	2

20th March 1829 (signed) G.E. AUBREY.

Source: P.P. 1834, XIX, *First Supplementary Report of the Factory Inquiry Commission.*

FIGURE 2

THE BOLTON AND OLDHAM LISTS



Source: Jewkes and Gray, *Wages and Labour*, 43.