

**Learning From Ricardo and Thompson: Machinery
and Labor in the Early Industrial Revolution and in
the Age of Artificial Intelligence**

**向 Ricardo 和 Thompson 学习：早期工业革命和人工智能时
代的机器和劳动力***

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摘要

David Ricardo initially believed machinery would help workers but revised his opinion, likely based on the impact of automation in the textile industry. Despite cotton textiles becoming one of the largest sectors in the British economy, real **wages** for cotton weavers did not rise for decades. As E.P. Thompson emphasized, automation forced workers into unhealthy factories with close surveillance and little autonomy. Automation can increase **wages**, but only when accompanied by new tasks that raise the marginal **productivity** of labor and/or when there is sufficient additional hiring in complementary sectors. **Wages** are unlikely to rise when workers cannot push for their share of **productivity** growth. Today, artificial intelligence may boost average **productivity**, but it also may replace many workers while degrading job quality for those who remain employed. As in Ricardo's time, the impact of automation on workers today is more complex than an automatic linkage from higher **productivity** to better **wages**. † David Ricardo 最初认为，机器可以帮助工人，但后来修改了他的观点，可能是基于自动化对纺织业的影响。尽管棉纺织业成为英国经济中最大的行业之一，但棉纺工人的实际工资，几十年来没有上涨。正如 E.P. Thompson 所强调的那样，自动化迫使工人进入不健康的工厂，这些工厂受到严密监控，几乎没有自主权。自动化可以提高工资，但只有在伴随着提高劳动力边际生产率的新任务和/或互补行业有足够的额外招聘时。当工人无法推动他们在生产率增长中的份额时，工资不太可能上涨。如今，人工智能可能会提高平均生产率，但也可能取代许多工人，同时降低那些仍在工作的人的工作质量。与Ricardo 时代一样，自动化对当今工人的影响，比从更高的生产率到更好的工资的自动联系，更复杂。

关键词 (Key words): automation, working conditions, Industrial Revolution † 自动化, 工作条件, 工业革命

常见词 (Frequently appeared words): **handloom**, **wages**, **productivity** † 手织, 工资, 生产率

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§1 INTRODUCTION † 引言

The jenny simply multiplied human hands while the water-frame was a substitute for human skill † 珍妮只是简单地增加了人手，而水架则是人类技能的替代品

—Chapman (1904, p. 53)

The Jennyes are in the Hands of the Poor and the Patent Machines are generally in the Hands of the Rich † 珍妮家族掌握在穷人手中，专利机器通常掌握在富人手中

—Hammond & Hammond (1919, p. 56)¹

According to conventional wisdom, any increase in total **productivity** is ultimately good for workers, at least on average.² In this long-established view among economists, technological change—including various forms of automation—always has the net effect of raising **wages** and generating more opportunity, creating an engine that pulls everyone along and leading directly to shared prosperity. This notion of a **productivity bandwagon** appears frequently today in discussions about the potential distributional impacts of developments in artificial intelligence (AI). † 根据传统观点，总**生产率**的任何增加，最终都有利于工作，至少就平均的意义而言。在经济学家们长期以来的观点中，技术变革——包括各种形式的自动化——总是具有提高**工资**和创造更多机会的净效应，创造了一个拉动每个人前进的引擎，直接导致共同繁荣。如今，在关于人工智能（AI）发展的潜在分布影响的讨论中，经常出现**生产率潮流**的概念。

Wages, consumption, and overall standards of living have certainly improved since the Industrial Revolution. Technological innovation has created new jobs, opportunities, and wealth. However, taking such a long view ignores the struggles of workers to secure their fair share of the prosperity made possible by new machinery. The fate of cotton workers in the early Industrial Revolution provides an illustrative example. In only a few decades, several hundred thousand skilled and well-compensated artisan weavers were displaced by a smaller number of power-loom workers who received a lower wage while enduring dangerous working conditions. With few outside options, and an inability to adapt to these unprecedented changes, **handloom** weavers suffered a precipitous fall in their real **wages**. Though economic historians have debated the precise course of economy-wide real **wages** during the early Indus-

¹This statement was made by cotton spinners to a Parliamentary Committee, which reported in 1780. It is quoted by Hammond & Hammond (1919, p. 56), who call this “a significant complaint that marks the rise of the new order of capitalism.” Jennys were small spinning machines, which could be operated in people’s homes or small workshops. Patent machines and water-frames refer to machinery that was operated in factories. † 这一声明是由棉纺厂向议会委员会发表的，该委员会于1780年提交了报告。Hammond & Hammond（1919年，第56页）引用了这句话，他们称之为“标志着资本主义新秩序兴起的重大抱怨”。珍妮是小型纺纱机，可以在人们的家中或小作坊里操作。专利机器和水架是指工厂中使用的机器。

²The precise empirical meaning of “ultimately” is important here. As Mokyr et al. (2015, p. 38) write about the early Industrial Revolution, “It is true that, in the long run, **wages** for laborers increased to reflect dramatically increased **productivity**. It is also true that, for the Industrial Revolution, by many estimates it took longer than an average working lifetime to do so, and in the long run, we are all dead.” † “最终”的确切经验意义，在这里很重要。正如Mokyr等人（2015，第38页）在谈到早期工业革命时所写的那样，“从长远来看，劳动者的工资确实会增加，以反映生产力的急剧提高。同样，对于工业革命来说，据许多人估计，这要比平均工作寿命更长的时间，从长远看，我们都死了。”

trial Revolution, the collapse of **wages** in weaving is incontrovertible.³ All the data suggest that real **wages** for **handloom** weavers more than halved between 1806 and 1820. † 自工业革命以来，工资、消费和整体生活水平，肯定有所提高。技术创新创造了新的就业机会、机会和财富。然而，从长远来看，忽视了工人为确保公平分享新机器带来的繁荣而进行的斗争。工业革命早期棉花工人的命运，提供了一个说明性的例子。在短短几十年内，数十万技术娴熟、报酬丰厚的手工织布工，被少数动力织布机工人取代，这些工人在忍受危险工作条件的同时，获得了较低的工资。由于外部选择很少，无法适应这些前所未有的变化，**手织**织布工的实际**工资**急剧下降。尽管经济历史学家，对工业革命早期整个经济体的实际工资的确切过程，进行了辩论，但纺织业的工资崩溃是无可争议的。所有数据表明，1806年至1820年间，**手织**织布工的实际工资，减半以上。

David Ricardo, a founder of modern economics, was an early and influential proponent of the **productivity** bandwagon (Ricardo 1817). In a much-quoted line, Ricardo told the House of Commons in 1819 that “machinery did not lessen the demand for labor.” This fit his broader view, again frequently referenced over the generations, that the spread of factories and large-scale production would necessarily benefit workers. † David Ricardo, 是现代经济学的创始人，也是**生产力**潮流的早期有影响力的支持者 (Ricardo 1817)。1819年，Ricardo 在下议院发表了一句被广泛引用的话：“机器并没有减少对劳动力的需求。”这符合几代人再次频繁引用的更广泛的观点，即工厂和大规模生产的扩张，必然会使工人受益。

Shortly after 1819, however, Ricardo revised his thinking on this key point. For the third edition of *On the Principles of Political Economy and Taxation* in 1821, he added a chapter, “On Machinery,” in which he wrote, “It is more incumbent on me to declare my opinion on this question, because they have, on further reflection, undergone a considerable change” (Ricardo 1821, p. 282). In a private letter written in the same year, he further added, “If machinery could do all the work that labor now does, there would be no demand for labor.”⁴ † 然而，1819年后不久，Ricardo 修改了他对这一关键点的看法。在1821年出版的《论政治经济学和税收原理》第三版中，他增加了一章“论机器”，他在其中写道：“我更有责任就这个问题发表意见，因为经过进一步思考，它们已经发生了相当大的变化” (Ricardo 1821, 第282页)。在同年写的一封私人信件中，他进一步补充道：“如果机器能完成现在劳动力所做的所有工作，就不会有劳动力需求。”

Understanding the context within which Ricardo shifted his thinking provides insight into why the **productivity** bandwagon can so easily break down. As a member of Parliament on the Select Committee on the Poor Laws, Ricardo witnessed first-hand the consequences of power looms in the cotton industry. These observations likely influenced his revised view of the impact of machinery on labor demand. † 理解 Ricardo 转变思维的背景，可以洞察为什么**生产力**潮流如此容易崩溃。作为济贫法特别委员会的议员，Ricardo 亲眼目睹了动力织机在棉花行业的影响。这些观察，可能影响了他对机械对劳动力需求影响的修正的观点。

Despite this substantial update to his worldview, Ricardo remained firmly focused on narrowly defined

³The best available data suggest that conditions (including **wages**, consumption, and public health) in highly innovative places such as Manchester were appalling in the 1830s. Prosperity was more widely shared later, likely after about 1850. † 现有的最佳数据表明，19世纪30年代，曼彻斯特等高度创新的地方的条件（包括**工资**、消费和公共卫生）令人震惊。后来，繁荣得到了更广泛的分享，可能是在1850年左右。

⁴Sraffa (1951, Vol. VIII, pp. 399 - 400), letter dated June 30, 1821. † Sraffa (1951年，第八卷，第399-400页)，1821年6月30日的信。

economic factors, that is, how technology influences worker **productivity** and, via this channel, its impact on **wages** and employment opportunities. The questions of who had power in factories, the value of worker autonomy, and working conditions more broadly did not feature significantly in Ricardo's writings or speeches. The importance of these issues during the Industrial Revolution was articulated by E.P. Thompson, most notably in *The Making of the English Working Class* (Thompson 1966). † 尽管 Ricardo 的世界观有了实质性的更新,但他仍然坚定地关注狭义的经济因素,即技术如何影响工人的生产力,并通过这一渠道影响工资和就业机会。谁在工厂里拥有权力、工人自治的价值以及更广泛的工作条件等问题,在 Ricardo 的著作或演讲中,并没有得到显著体现。E.P. Thompson, 尤其在《英国工人阶级的形成》(Thompson 1966)中,阐述了这些问题在工业革命期间的重要性。

Writing in the early 1960s and drawing on a wide range of sources from the early 1800s, Thompson (and other historians in the Marxist tradition, such as Eric Hobsbawm) argued that the spread of the factory system did not improve the lives of workers in the innovating sectors (such as cotton) and had only limited positive effects on workers in other sectors. For Thompson, the movement of workers into factories shifted the balance of power between workers and capital, and consequently working conditions deteriorated. † Thompson (和其他马克思主义传统历史学家,如 Eric Hobsbawm) 在20世纪60年代初写作,并借鉴了19世纪初的大量资料,认为工厂制度的传播,并没有改善创新部门(如棉花)工人的生活,对其他部门工人的积极影响有限。对 Thompson 来说,工人进入工厂的运动,改变了工人和资本之间的权力平衡,因此工作条件恶化了。

Specifically, workers lost autonomy over their lives; they were increasingly forced, because of a lack of viable alternative sources of income, to work long, monotonous hours in unhealthy conditions, while also living in overcrowded and highly unsanitary cities.⁵ All of this was made possible by government coercion which actively prevented workers from combining (i.e., bargaining collectively) to push for higher **wages**, better working conditions, or political reform. † 具体而言,工人失去了对生活的自主权;由于缺乏可行的替代收入来源,他们越来越被迫在不健康的条件下长时间、单调地工作,同时还生活在过度拥挤和高度不卫生的城市中。所有这一切,都是由于政府的强制措施造成的,政府积极阻止工人联合起来(即集体谈判)争取更高的工资、更好的工作条件或政治改革。

In previous work (Acemoglu & Johnson 2023), we propose a framework that blends Ricardo's and Thompson's ideas to clarify when new technologies improve the lot of workers. For the benefits of growth to be shared, the right combination of technological and political conditions must exist. † 在之前的工作 (Acemoglu & Johnson 2023) 中,我们提出了一个融合 Ricardo & Thompson 思想的框架,以阐明新技术何时改善了工人的命运。为了分享增长的好处,必须存在技术和政治条件的正确结合。

New technologies can reduce the value of marginal **productivity** for workers even as they raise average **productivity**.⁶ Most saliently, automation—the substitution of machinery for tasks previously performed by workers—displaces workers and can reduce, rather than increase, the demand for labor.

⁵As put by Mokyr et al. (2015, p. 35), “The problem with the factories was not in the low quantity of work they offered, but the low quality of work in the mills.” † 正如 Mokyr 等人 (2015, 第35页) 所说,“工厂的问题不在于他们提供的工作量少,而在于工厂的工作质量低。”

⁶The short version of how this can happen is as follows. A technological improvement increases output for given quantities of factors of production and thus raises average labor **productivity**. Demand for labor, as well as employment and **wages**, is determined by labor's marginal **productivity** (or, more precisely, by the value of the marginal product of labor). The general presumption is that average and marginal **productivity** of labor should move together, but there is no theoretical guarantee for this. They do so when the aggregate production function of the economy can be approximated by

This is what happened to [handloom](#) weavers. † 新技术可以降低工人的边际生产率的价值，即使它们提高了平均生产率。最引人注目的是，自动化——用机器代替以前由工人完成的任务——取代了工人，可以减少而不是增加对劳动力的需求。这就是[手织机](#)织布工的情况。

Automation does not necessarily mean the impoverishment of labor, however. First, when automation significantly increases [productivity](#) in some sectors, it can benefit labor. This could be either because automating sectors themselves grow sufficiently and demand for labor in non-automated tasks increases, or because other industries producing complementary products expand their hiring. This is what took place in the last decades of the eighteenth century as various tasks in spinning were mechanized, and this automation process triggered a massive expansion in [handloom](#) weaving. Even in such cases, however, automation tends to reduce labor's share of industry value added and, more broadly, labor's share of national income, so the [productivity](#) increase benefits capital more than labor.⁷ † 然而，自动化，并不一定意味着劳动力的贫困。首先，当自动化显著提高某些行业的生产率时，它可以使劳动力受益。这可能是因为自动化行业本身发展充分，对非自动化任务的劳动力需求增加，也可能是因为生产互补产品的其他行业扩大了招聘。这就是18世纪最后几十年发生的事情，当时纺纱的各种任务都是机械化的，而这一自动化过程，引发了织布业的大规模扩张。然而，即使在这种情况下，自动化，也往往会降低劳动力在工业增加值中的份额，更广泛地说，还会降低劳动力在国民收入中的份额。因此，生产率的提高，使资本比劳动力受益更多。

Second, and more powerfully, automation can be coupled with the creation of new tasks, which raise the marginal [productivity](#) of labor in new activities and overall labor demand.⁸ Although such a Cobb-Douglas function, which imposes that these two quantities be proportional to each other. The same conclusion also applies when the aggregate production function exhibits constant returns to scale and the [cost of capital](#) remains constant even as the demand for capital increases. In general, however, there is no such guarantee, and automation—defined as machines taking over tasks previously performed by labor—expands the wedge between average and marginal [productivity](#) of labor (see Acemoglu & Restrepo 2018, 2019 for discussion). † 这种情况如何发生的简短版本如下。技术改进，提高了给定数量的生产要素的产量，从而提高了平均劳动生产率。对劳动力、就业和工资的需求，是由劳动力的边际生产率（或者更确切地说，按劳动边际产品的价值）决定的。一般的假设是，劳动力的平均和边际生产率应该一起移动，但这在理论上没有保证。当经济的总生产函数可以用柯布-道格拉斯函数近似时，它们就会这样做，该函数要求这两个量彼此成比例。当总生产函数表现出恒定的规模回报，并且即使资本需求增加，资本成本也保持不变时，同样的结论也适用。然而，总的来说，没有这样的保证，自动化定义的机器，接管以前由劳动力执行的任务，扩大了劳动力的平均和边际生产率之间的差距（讨论见Acemoglu & Restrepo 2018, 2019）。

⁷Because automation reduces costs, sectors adopting automation technologies may expand employment and thus increase hiring in nonautomated tasks (Acemoglu & Restrepo 2019). Whether they do so or not will depend on the demand elasticity for their product. Additionally, automation in one sector increases incomes and demand for other goods, so that other industries may start hiring more (Acemoglu & Restrepo 2019, Aghion et al. 2019). Via both channels, automation may end up increasing the demand for labor and thus equilibrium [wages](#), but there is no guarantee that it will do so. Acemoglu & Restrepo (2019) provide a simple decomposition of the full effects of technological changes, including sectoral reallocation of labor, on overall labor demand in the economy. † 由于自动化降低了成本，采用自动化技术的行业可能会扩大就业，从而增加非自动化任务的招聘 (Acemoglu & Restrepo 2019)。他们是否这样做将取决于其产品的需求弹性。此外，一个行业的自动化增加了收入和对其他商品的需求，因此其他行业可能会开始雇佣更多人 (Acemoglu & Restrepo 2019, Aghion等人2019)。通过这两种渠道，自动化最终可能会增加对劳动力的需求，从而增加均衡[wages](#)，但不能保证它会这样做。Acemoglu & Restrepo (2019) 对技术变革的全部影响进行了简单的分解，包括劳动力的部门重新分配，对经济中的整体劳动力需求。

⁸While automation reduces the labor share of national income, and increases in the physical [productivity](#) of labor have ambiguous and generally small effects on the labor share, new labor-intensive tasks increase the labor share as well as [wages](#) and employment, because they reinstate labor centrally into the production process (see Acemoglu & Restrepo 2018, 2019). † 虽然自动化降低了国民收入中的劳动力份额，并且劳动力的物理生产率的增加对劳动力份额的影响是

new tasks were important in the second half of the nineteenth century, they were not a central feature of industrialization until at least the beginning of the railway age in the 1830s and were not widespread until after about 1850 (Acemoglu & Johnson 2023). † 其次,更有力的是,自动化可以与新任务的创建相结合,这提高了新活动中劳动力的边际生产率和整体劳动力需求。尽管这些新任务,在19世纪下半叶很重要,但至少到19世纪30年代铁路时代开始之前,它们并不是工业化的核心特征,直到1850年左右才得到广泛应用 (Acemoglu & Johnson 2023)。

In line with Thompson's emphasis, even technological developments that favor labor are not sufficient to guarantee that workers will benefit. Whether workers gain or not depends on who has power. When political power is in the hands of a narrow elite and workers lack the ability to bargain collectively, their wages and working conditions may not improve.⁹ The fact that British workers lacked both political voice and the legal right to bargain collectively is critical to understanding why they did not benefit from productivity gains during the early stages of the Industrial Revolution. † 与 Thompson 的强调一致,即使是有利于劳动力的技术发展,也不足以保证工人受益。工人是否受益,取决于谁拥有权力。当政治权力掌握在少数精英手中,工人缺乏集体谈判的能力时,他们的工资和工作条件,可能不会得到改善。英国工人既缺乏政治发言权,也缺乏集体谈判的合法权利,这一事实对于理解为什么他们在工业革命早期没有从生产率的提高中受益至关重要。¹⁰

Both the technological and political pillars of shared prosperity remain important today, including in debates about the potential impact of AI. For this reason, understanding why Ricardo may have changed his mind remains highly relevant today. In the early 1820s, Ricardo reconsidered the productivity bandwagon after witnessing first-hand, and over at least a decade, the consequences of the first Industrial Revolution. In the 2020s, we should be able to learn from history and apply relevant lessons more effectively. It is not unreasonable to want to do better than Ricardo's generation in terms of ensuring that potential prosperity through innovation is more equally shared. † 共享繁荣的技术和政

模糊的,而且通常很小,但新的劳动密集型任务增加了劳动力份额以及工资和就业,因为它们将劳动力集中恢复到生产过程中(见Acemoglu & Restrepo 2018,2019)。

⁹In settings where wages are determined via bargaining, low bargaining power of workers would lead to most of the gains from new technology being captured by firms (or dissipated by additional firm entry). Pissarides (2000) provides a textbook treatment of search-and-bargaining models. More interestingly, some types of technologies, such as those that facilitate monitoring, may shift bargaining power or quasi-rents from workers to firms (see, e.g., Acemoglu & Newman 2002). In addition, in models where employers have access to coercive capabilities or other ways of shifting quasi-rents away from workers, an increase in productivity can be associated with lower wages (see, e.g., Acemoglu & Wolitzky 2011). † 在工资通过谈判确定的情况下,工人的议价能力低,将导致新技术的大部分收益被公司获得(或因额外的公司进入而消散)。Pissarides (2000) 对搜索和讨价还价模型,进行了教科书式的处理。更有趣的是,某些类型的技术,如那些有助于监控的技术,可能会将议价能力或准租金从工人转移到公司(参见Acemoglu和Newman 2002)。此外,在雇主可以获得强制能力或以其他方式将准租金从工人身上转移出去的模型中,生产率的增加可能与较低的工资有关(参见Acemoglu & Wolitzky 2011)。

¹⁰Less than 10% of the British adult male population was allowed to vote before 1832. The political system of the eighteenth century was dominated by landowners, and protecting property was a primary goal for the political system (Williams 1939). This changed with the rise of manufacturing in the north of England, but initially only so far as increasing the economic power, and then the political voice, of the people who owned factories. For most of the nineteenth century, these owners of capital were more directly in confrontation with worker interests than was the aristocracy (see the discussion in Acemoglu & Johnson 2023, chapter 5). † 1832年之前,只有不到10%的英国成年男性被允许投票。十八世纪的政治制度由地主主导,保护财产是政治制度的主要目标(Williams 1939)。随着英格兰北部制造业的兴起,这种情况发生了变化,但最初只是增加了工厂所有者的经济实力,然后是政治声音。在19世纪的大部分时间里,这些资本所有者比贵族更直接地与工人利益对抗(见Acemoglu & Johnson 2023第5章的讨论)

治支柱，在今天仍然很重要，包括在关于人工智能潜在影响的辩论中。因此，理解 Ricardo 可能改变主意的原因，在今天仍然非常重要。19世纪20年代初，Ricardo在亲眼目睹了第一次工业革命至少十年的后果后，重新考虑了生产率潮流。在21世纪20年代，我们应该能够从历史中吸取教训，更有效地应用相关经验教训。在确保通过创新实现的潜在繁荣得到更平等的分享方面，想要比 Ricardo 这一代人做得更好，并非没有道理。

This article explores the rise and fall of **handloom** weaving, based on the best available evidence regarding how relevant measures of real **wages** changed in this early phase of British industrialization. Section 2 sets the scene, with the rise of cotton as a large part of the British economy after 1780. Section 3 reviews what is known about when exactly Ricardo changed his view on machinery. Section 4 contains our analysis of what happened to **handloom** weavers, in terms of nominal **wages**, real **wages**, and employment and of how long it took for offsetting positive developments in other parts of the economy to emerge. Section 5 incorporates ideas highlighted by E.P. Thompson, which further emphasize the ways in which automation made many **handloom** workers (and others) worse off, at least until industrialization significantly boosted the demand for labor. Section 6 links these historical developments to what we are likely to experience in the age of AI and emphasizes the importance of choices on whether new technologies automate work or create new tasks for labor, whether new technologies monitor or empower workers, and how institutions evolve to share **productivity** gains (or not). Section 7 concludes. Our **Supplemental Appendix** reviews the wage and price data from early 1800s Britain in more detail. † 本文基于现有的最佳证据，探讨了手织机织造的兴衰，这些证据表明，在英国工业化的早期阶段，实际工资的相关指标，是如何变化的。第2节讲述了1780年后，棉花作为英国经济重要组成部分的崛起。第3节回顾了 Ricardo 何时改变了对机器的看法。第4节包含我们对手织机织布工发生的事情的分析，包括名义工资、实际薪资和就业，以及抵消其他经济领域的积极发展所需的时间。第5节结合了E.P.Thompson强调的观点，该观点进一步强调了，自动化如何使许多手织机工人（和其他人）的处境变得更糟，至少在工业化显著提振劳动力需求之前，是这样。第6节将这些历史发展与我们在人工智能时代可能经历的情况，联系起来，并强调了选择新技术，是自动化工作还是为劳动力创造新任务的重要性，新技术是监控还是赋予工人权力，以及机构如何发展以分享生产率的提高（或不提高）。第7节结束。我们的补充附录，更详细地回顾了19世纪初英国的工资和价格数据。

§2 THE RISE OF COTTON † 棉花的兴起

Most narrative histories of the Industrial Revolution emphasize the importance of the British cotton industry as one of the first to see widescale adoption of machinery in factories. The development of spinning machines in the 1770s signaled the beginning of the sector's transformation. Broadly, the production of cotton textiles begins with spinning raw cotton into yarn, which then must be woven into fabric. The dominant industrial fact of the late eighteenth century was that the use of machines to spin cotton greatly increased labor **productivity**.¹¹ † 大多数关于工业革命的叙述性历史，都强调了英国

¹¹The back story is slightly more complicated. In the early eighteenth century, raw cotton was imported from India and other colonies, in part because trade restrictions limited the import of cotton cloth or clothing at the behest of the more established British wool and silk industries. The first significant technological improvements were in weaving, which boosted the demand for yarn and encouraged the development of machines for spinning. However, those early weaving machines were what became known as **handlooms**; they were worked by one person, often with assistants (typically family

棉花工业的重要性，因为它是最早在工厂大规模采用机器的行业之一。18世纪70年代纺纱机的发展，标志着该行业转型的开始。广义上讲，棉纺织品的生产，始于将原棉纺成纱线，然后必须将纱线织成织物。十八世纪末的主要工业事实是，使用机器纺织棉花，大大提高了劳动生产率。

In the early 1700s, it took over 50,000 person hours to spin (i.e., turn raw cotton into yarn that could be woven) 100 pounds of cotton. Indian spinners were regarded as the most productive in the world, and they produced the best-quality product. From 1760, however, this labor requirement fell quickly as machines were invented and quickly improved. Labor required was 2,000 hours per 100 pounds of cotton after the introduction of Samuel Crompton's mule in 1780, 1,000 hours after the introduction of the 100-spindle mule around 1790, and just 300 hours with the arrival of "power-assisted mules" around 1795 (Chapman 1987, p. 20). These machines represented a significant capital cost, and all were deployed in what were then large factories, initially with several hundred workers, rising quickly in some cases to between 1,000 and 1,500 employees (Freeman 2018). Putting machines in factories allowed owners to control who had access to the machines and to determine working conditions. † 在18世纪初，纺100磅棉花（即将原棉变成可以编织的纱线）需要5万多人小时。印度纺纱厂被认为是世界上产量最高的，他们生产的产品质量最好。然而，从1760年开始，随着机器的发明和快速改进，这一劳动力需求迅速下降。1780年引入Samuel Crompton的骡子后，每100磅棉花所需的劳动力为2000小时，1790年左右引入100锭骡子后为1000小时，1795年左右“助力骡子”问世后仅需300小时（Chapman 1987，第20页）。这些机器，代表了巨大的资本成本，所有这些机器，都部署在当时的大型工厂中，最初有几百名工人，在某些情况下，迅速增加到1000到1500名员工（Freeman 2018）。将机器放在工厂里，让业主可以控制，谁可以使用机器，并决定工作条件。¹²

While the industrialization of spinning displaced some proto-industrial spinners, the explosion of cheap yarn in need of weaving created new and lucrative employment in [handloom](#) weaving. Prior to around 1820, weaving remained a cottage industry, primarily performed by men, women, and children in the home. A trade that was easily learned, could be performed in the home, and required minimal upfront investment, weaving attracted thousands, including many former spinners (Bythell 1969). It was in the context of this golden age of weaving from around 1780 to 1800 that Ricardo likely formed his early views on automation and labor. However, coinciding with the growing adoption of power looms during the 1810s and the accompanying collapse in [handloom](#) weavers' wages, Ricardo's views changed. † 虽然纺纱的工业化取代了一些原始工业纺纱厂，但需要织造的廉价纱线的爆炸式增长为[纺织业](#)创造了新的利润丰厚的就业机会。在1820年之前，织布仍然是一种家庭手工业，主要由男人、女人和孩子在家里完成。织布是一种很容易学习、可以在家里进行、只需要很少的前期投资的贸易，吸引了数千人，其中包括许多前纺纱商（Bythell 1969）。正是在1780年至1800年左右的织造黄金时代，Ricardo

members), and at home. † 背景故事稍微复杂一些。18世纪初，原棉从印度和其他殖民地进口，部分原因是贸易限制限制了在更成熟的英国羊毛和丝绸工业的要求下，进口棉布或服装。第一次重大的技术改进，是在织造方面，这增加了对纱线的需求，并鼓励了纺纱机器的发展。然而，那些早期的织布机，就是后来被称为 [handloom](#) 的机器，他们由一个人在家工作，通常有助手（通常是家庭成员）。

¹²Not all the inventors prospered. This was a highly competitive industry, and the big profits fell into the hands of those who could grab market share and defend their intellectual property rights. Richard Arkwright became fabulously wealthy from his efforts in the spinning industry. Crompton died poor. Hobsbawm (1996, chapter 2) has a good discussion of profits and entrepreneurs. † 并非所有的发明家都成功了。这是一个竞争激烈的行业，巨额利润，落入了那些能够抢占市场份额并捍卫知识产权的人手中。理Richard Arkwright 通过在纺织业的努力变得极其富有。Crompton 死得很穷。Hobsbawm (1996，第2章)对利润和企业家进行了很好的讨论。

可能形成了他对自动化和劳动的早期观点。然而，随着19世纪10年代动力织机的日益普及，以及随之而来的手织机织布工工资的崩溃，Ricardo 的观点发生了变化。

§3 RICARDO'S PIVOT † RICARDO 的转变

In 1817 the first edition of Ricardo's *Principles* made no mention of the potential ill-effects of machinery on workers. By 1821, however, Ricardo had apparently changed his mind on this point—hence the chapter “On Machinery” in the third edition of the work, which appeared that year. † 1817年，《Ricardo's *Principles*》第一版，没有提到机器对工人的潜在不良影响。然而，到1821年，Ricardo 显然在这一点上改变了主意—因此，当年出版的这本书第三版中，有一章“论机械”。¹³

One possibility is that Ricardo was swayed by John Barton's (1817) *Observations on the Circumstances Which Influence the Condition of the Labouring Classes of Society*.¹⁴ However, Ricardo had considered and rejected Barton's argument in 1817 when drafting the first edition of *Principles*, so his change of opinion is more likely to have been spurred by events.¹⁵ Ricardo became a member of Parliament in 1819, and while no one has spotted a particular “aha” moment, it seems likely that current political conditions played a role in Ricardo's change of mind, including repeated expressions of anger and frustration by handloom weavers (Henderson & Davis 1997). † 一种可能性是，Ricardo 受到了 John Barton (1817) 《关于影响劳动阶级社会状况的环境的观察》的影响。然而，Ricardo 在1817年起草《原理》第一版时，考虑并拒绝了巴顿的论点，因此，他的观点变化，更有可能是由事件引起的。Ricardo于1819年成为议员，虽然没有人发现一个特别的“啊哈”时刻，但似乎当时的政治条件，在 Ricardo 改变主意方面发挥了作用，包括织布工反复表达的愤怒和沮丧 (Henderson & Davis 1997)。

Hammond & Hammond (1919) provide a detailed narrative history of cotton workers' grievances and protests. These complaints were not new in the late 1810s, but they reached something of a crescendo in 1818 - 1819 (pp. 112 - 18). Concerns about wages and frustration regarding the lack of parliamentary response increasingly led to demands for reform, meaning expanded representation in the Parliament. This push for democracy was seen as threatening by many members of the elite. A major demonstration, with perhaps 60,000 people expressing support for political reform, was broken up by force in Manchester in August 1819. The so-called Peterloo Massacre shook the country; the link to handloom worker discontent was evident (Hernon 2006, pp. 22 - 24).¹⁶ Hammond & Hammond (1919)

¹³We should point out there are various plausible views on what Ricardo meant by adding this chapter. In the reading of Mokyr et al. (2015, p. 33), for example, Ricardo felt “that in the long run higher productivity would lead to higher saving and eventually rising demand for labor.” † 我们应该指出，对于李嘉图添加这一章的含义，有各种合理的观点。例如，在 Mokyr 等人 (2015年，第33页) 的阅读中，Ricardo 认为“从长远来看，更高的生产率将导致更高的储蓄，并最终导致劳动力需求的增加。”

¹⁴Hayek (1941, p. 424), Sotiropoulos (1952, p. 94), Gourvitch (1966, pp. 58 - 59), Henderson & Davis (1997, pp. 576,579), and Schumpeter (2006, pp. 650 - 51) all note the similarity of Ricardo's reasoning in “On Machinery” to Barton's argument in *Observations*. † Hayek (1941, 第424页)、Sotiropoulos (1952, 第94页)、Gourvitch (1966, 第58-59页)、Henderson & Davis (1997, 第576-579页) 和 Schumpeter (2006, 第650-51页) 都注意到，Ricardo 在《论机械》中的推理，与 Barton 在《观察》中的论证相似。

¹⁵Barton wrote to Ricardo directly arguing that machinery could reduce labor demand. Ricardo rejected this argument in his response dated May 20, 1817 (Sraffa 1951, Vol. VII, pp. 156 - 59). † Barton 直接写信给 Ricardo，认为机器可以减少劳动力需求。Ricardo 在1817年5月20日的回复中，驳斥了这一论点 (Sraffa 1951, 第七卷, 第156-59页)

¹⁶The Peterloo Massacre took place on St. Peter's Field, Manchester. “Peterloo” is an ironic reference to the Battle

详细叙述了棉花工人的不满和抗议历史。这些抱怨，在19世纪10年代末并不新鲜，但在1818-1819年达到了高潮（第112-18页）。对工资的担忧，和对议会缺乏回应的沮丧，越来越多地导致了改革的要求，这意味着扩大了议会的代表性。这种对民主的推动，被许多精英阶层视为威胁。1819年8月，曼彻斯特发生了一场大规模的示威活动，约有6万人表示支持政治改革，但被武力驱散。所谓的 Peterloo 大屠杀，震撼了整个国家；与手织机工人不满的联系是显而易见的（Hernon 2006，第22-24页）。

In contrast to the intense and repeated debates about power looms for weaving, earlier protests against spinning machinery had not proved long lasting. Hammond & Hammond (1919, p. 56) point out: † 与关于电动织布机织造的激烈和反复的辩论相反，早些时候对纺纱机械的抗议，并没有持续多久。Hammond & Hammond (1919, 第56页)指出：

After these riots in 1779 the workers made no more attempts to check the introduction of machinery for spinning. The reason no doubt lies in the fact that whenever any labor was displaced by the introduction of any particular species of machinery for spinning, it was soon absorbed by an expansion of trade. Many of the economists of the day, with this example before them, came to think that the introduction of machinery would be a similarly painless process in every case. The weaving trade offered employment to any surplus labor from spinning. † 1779年这些骚乱之后，工人们不再试图阻止纺纱机械的引入。毫无疑问，原因在于，每当任何劳动力因引进任何特定种类的纺纱机械而被取代时，它很快就会被贸易的扩张所吸收。有了这个例子，当时的许多经济学家开始认为，在任何情况下，引入机器，都是一个同样无痛的过程。纺织贸易，为纺织业的剩余劳动力提供了就业机会。

This relatively positive experience with spinning machinery helps explain Ricardo's first take on the issue, for example, as expressed directly to Barton (in a letter on May 20, 1817; see Sraffa 1951, Vol. VII, p. 159): “[T]here is no new creation of machinery which entirely supersedes the use of the labor of man.” (Readers are referred to the discussion in Henderson & Davis 1997, pp. 577 - 79.) † 这种相对积极的纺纱机器经验，有助于解释 Ricardo 对这个问题的第一次看法，例如，直接向 Barton 表达的观点（在1817年5月20日的一封信中；见Sraffa 1951，第七卷，第159页）：“没有任何新的机器创造，能完全取代人类劳动的使用。”（读者可参考 Henderson & Davis 1997，第577-79页的讨论。）

From 1819, Ricardo was a member of the Parliamentary Select Committee on the Poor Laws. In this capacity he was undoubtedly aware of the overwhelming evidence that a large number of workers struggled to earn a living. In his maiden speech, on March 25, 1819, he acknowledged “the inadequacy of the wages to the support of the labouring classes” as one of “two great evils for which it was desirable to provide a remedy” (Cannan 1894, p. 414). † 从1819年开始，Ricardo 是议会济贫法特别委员会的成员。在这个职位上，他无疑意识到，大量工人为谋生而挣扎的压倒性证据。在1819年3月25日的首次演讲中，他承认“工资，不足以支持工人阶级”是“需要补救的两大罪恶之一”（Cannan 1894，第414页）。

By 1820, as we discuss below, Ricardo had good reason to think that the introduction of improved weaving machinery, specifically the power loom in factories, would not necessarily — or any time soon — lead to widely shared prosperity. To better understand this critical period of economic upheaval, we now turn to Waterloo in 1815. For further details, readers are referred to <https://www.peterloomassacre.org/history.html>. † 彼得鲁大屠杀发生在曼彻斯特圣彼得球场。“彼得鲁”是对1815年滑铁卢战役的讽刺。有关更多详细信息，请参阅 <https://www.peterloomassacre.org/history.html>。

to the best available evidence on **wages** and inflation, which confirms that Ricardo's concerns were well warranted: **handloom** weavers suffered greatly with the adoption of power looms, and unlike the case of the spinners before them, there was little compensatory wage or employment growth elsewhere in the economy. † 到1820年, 正如我们下面讨论的那样, Ricardo 有充分的理由认为, 引入改进的织造机器, 特别是工厂中的动力织机, 不一定——也不可能很快——会导致广泛共享的繁荣。为了更好地理解这一经济动荡的关键时期, 我们现在转向关于**工资**和通货膨胀的最佳证据, 这证实了 Ricardo 的担忧, 是有充分理由的: **手织机**织布工, 在采用动力织布机时遭受了巨大的损失, 与之前的纺纱工不同, 经济中其他地方, 几乎没有补偿性的工资、或就业增长。

§4 LABOR DEMAND AND **WAGES** IN THE EARLY INDUSTRIAL REVOLUTION † 工业革命初期的劳动力需求与工资

We start with the **wages** and employment of **handloom** weavers as the power loom was adopted.¹⁷ As discussed in the Introduction, the impact of automation can always extend beyond the tasks that are automated, and broader effects can manifest in various ways. Moreover, as we have already emphasized and as illustrated by the example of the early **cotton spinners**, automation can trigger the creation of new tasks or even new opportunities in related—upstream or downstream—sectors. † 我们从**工资**和**手织**织布工开始, 因为采用了动力织机。正如引言中所讨论的, 自动化的影响, 总是可以超越自动化的任务, 更广泛的影响, 可以通过各种方式体现出来。此外, 正如我们已经强调的, 以及早期棉纺厂的例子所示, 自动化可以在相关的上游或下游行业, 引发新任务甚至创造新机会。

After **handloom** weavers, we turn to data on other cotton workers (factory operatives), and then to other sectors for which there are good data (mining, building, and agriculture). Finally, we assess the best available series for economy-wide **wages**. Drawing on this evidence, we find that real **wages** for **handloom** weavers collapsed between 1800 and the early 1820s. Despite real **wages** nearly halving, hundreds of thousands of people (mostly adult men) remained in the profession. † 在**手织**织布工之后, 我们转向其他棉花工人(工厂操作员)的数据, 然后转向其他有良好数据的行业(采矿、建筑和农业)。最后, 我们评估了经济体**工资**的最佳可用系列。根据这一证据, 我们发现, 在1800年至19世纪20年代初, **手织**织布工的实际工资水平下降了。尽管实际工资, 几乎减半, 但仍有数十万人(主要是成年男性)继续从事这一行业。

With economy-wide real **wages** stagnating until at least the 1820s, we find little evidence for offsetting employment or wage gains in other industries. For all wage developments, we discuss the nominal numbers first, with a preference for series in shillings and pence (the most transparent and easiest way to compare across sectors), and then convert them into real terms. Over the decades, there has been some debate about the best consumer price indices to use, but this has now settled down, as we review in the **Supplemental Appendix**. † 由于整个经济体的实际工资, 至少在19世纪20年代之前一直停滞不前, 我们发现, 几乎没有证据, 可以抵消其他行业的就业或工资增长。对于所有工资发展, 我们首先讨论名义数字, 优先考虑先令和便士的序列(跨部门比较最透明、最简单的方法), 然后将其转换为实际

¹⁷Our historical discussion draws directly on the best available data sources, most of which have already been used effectively by leading researchers such as Hunt (1981), Mokyr (2009, chapters 7, 18), and Allen (2018). † 我们的历史讨论, 直接借鉴了现有的最佳数据源, 其中大部分, 已被 Hunt (1981)、Mokyr (2009, 第7、18章) 和 Allen (2018) 等顶尖研究人员有效使用。

值。几十年来，关于使用最佳消费者价格指数，一直存在一些争论，但正如我们在补充附录中回顾的那样，这一点现在已经解决了。

§4.1 The Cotton Boom † 棉花暴涨

The **productivity** boom in spinning converted cotton from a modest cottage industry to a major sector in the British economy. In the early 1780s, the cotton industry was small (accounting for about 1% of British GDP), rising to 4 - 5% in 1805 - 1807 and to 7 - 8% in 1811 - 1813 (Chapman 1987, p. 55). There was a matching, and dramatic, increase in the UK annual import of raw cotton from 26m pounds in 1791 - 1795 to 300m pounds in 1831 - 1835 (Chapman 1904, p. 144).¹⁸ Cotton manufacture was the booming industrial sector of the early 1800s in Britain.¹⁹ † 纺织业的繁荣，将棉花从一个规模不大的家庭手工业转变为英国经济的主要部门。18世纪80年代初，棉花产业规模较小（约占英国国内生产总值的1%），1805-1807年，增至4-5%，1811-1813年增至7-8%（Chapman 1987，第55页）。英国原棉年进口量，从1791-1795年的2600万磅，增加到1831-1835年的3亿磅，增幅相当大（Chapman 1904，第144页）。棉花制造业，是19世纪初英国蓬勃发展的工业部门。

Cotton goods became a major export from Britain. In 1784 - 1786, total British exports were worth 12.7m pounds, and cotton exports were valued at 0.8m pounds (6% of total exports). By 1814 - 1816, total exports were 44.4m pounds and cotton exports were 18.7m pounds, making up 42.1% of total exports by value (Davis 1979, p. 15). † 棉花商品成为英国的主要出口商品。1784年至1786年，英国出口总额为1270万英镑，棉花出口额为80万英镑（占出口总额的6%）。到1814-1816年，出口总额为4440万磅，棉花出口额为1870万磅，占出口总额的42.1%（Davis 1979，第15页）。

Almost all cotton weaving in Britain was done on **handlooms** until at least 1806. There was some employment in power-loom factories from 1813, but by 1820 cotton factories still employed only about 10,000 workers in weaving.²⁰ The total number of power looms was estimated at 2,400 in 1813 and 14,150

¹⁸According to Chapman (1987, p. 36) “the United States cotton crop rose from 2 million lbs. in 1791 to 182 million lbs. in 1821, becoming the major source of Lancashire’s supply at the turn of the century…… The high elasticity of the supply of cotton, due primarily to the responsiveness of the American planters and the adoption of Whitney’s cotton gin, was clearly a crucial factor in the phenomenal growth of the British cotton industry in these years.” Like a number of other economic historians of this period, he makes no mention of the increasing intensity of slavery, the forced migration of enslaved people across the Deep South, or the long-lasting ill-effects of slave plantation cotton agriculture on political institutions and social development (see for example Acemoglu & Johnson 2023, chapter 4; Baptist 2014; Beckert 2014). Supplemental Table A3 has a slightly different series from the one used by Mitchell (1984) for total imports of raw cotton, but the trend is the same. † 根据 Chapman (1987, 第36页) 的说法，“美国棉花产量，从1791年的200万磅增加到1821年为1.82亿磅，在世纪之交成为 Lancashire 的主要供应来源…… 棉花供应的高弹性，主要是由于美国种植园主和 Whitney 轧棉机的采用，显然是这些年的英国棉花产业惊人增长的关键因素。”与这一时期的许多其他经济历史学家一样，他没有提到奴隶制日益加剧、被奴役者被迫穿越深南地区或奴隶种植园棉花农业，对政治制度和社会发展的长期不良影响（例如，见 Acemoglu & Johnson 2023，第4章；Baptist 2014；Beckert 2014）。补充表A3，与 Mitchell (1984) 用于原棉总进口量的系列略有不同，但趋势是相同的。

¹⁹Other transformations were underway, including in coal mining, the working of metals (ferrous and nonferrous), and steam engines. However, in the decades under consideration, widespread adoption of factory-based machines—and the consequent displacement of labor in more artisanal production—was a central feature only in the cotton industry (see Mokyr 2009, p. 452). † 其他转型正在进行中，包括煤矿开采、金属加工（黑色金属和有色金属）和蒸汽机。然而，在所考虑的几十年里，工厂机器的广泛采用以及随之而来的手工生产中劳动力的转移只是棉花行业的一个核心特征（见 Mokyr 2009，第452页）。

²⁰The power loom came into much wider use “in the 1820s” (Bythell 1969, p. 103). † 动力织机，在“19世纪20年代”得到了更广泛的应用（Bythell 1969，第103页）。

in 1820. We do not have an annual series, but the evidence suggests an acceleration of adoption during the time Ricardo was rethinking his views.²¹ The rise and fall of handloom weavers was a well-known and much discussed feature of the early British cotton industry. † 至少直到1806年，英国几乎所有的棉花织造，都是在手织机上完成的。从1813年开始，动力织机厂就有一些就业机会，但到1820年，棉纺厂仍然只雇佣了大约1万名织布工人。1813年，动力织机的总数，估计为2400台，1820年为14150台。我们没有年度系列，但有证据表明，在 Ricardo 重新思考自己的观点期间，采用速度有所加快。手织织布工的兴衰，是早期英国棉花工业的一个众所周知且备受讨论的特征。

§4.2 What Happened to Handloom Weavers? † 手织机织布工怎么了？

Facing new competition in the form of mechanized weaving, how did the handloom weavers fare? The best available evidence indicates that wages steadily declined in both nominal and real terms. Despite real wages falling to nearly a quarter of their golden age peak, hundreds of thousands of handloom weavers remained in the occupation and struggled to survive. † 面对机械化织造形式的新竞争，手织织布工的表现如何？现有的最佳证据表明，名义和实际工资均稳步下降。尽管real工资降至黄金时代峰值的近四分之一，但仍有数十万人手织织布工仍留在占领区，挣扎求生。

§4.2.1 Nominal wages † 名义工资

As part of his work on the statistics of wages in the nineteenth century, Wood (1910a - e) used primary sources to compile series for wages and employment in the cotton industry through the nineteenth century. Wood's series include separate estimates for workers in factories and for handloom weavers. His full series runs from 1806 to 1862 and is available annually (Wood 1910e, pp. 598 - 99, table 41). Wood finds that nominal weekly wages for handloom weavers fell steadily from 240d (old pence) in 1806 to 99d in 1820. In the same period, wages for factory workers remained stable at around 120d. (The change in relative wages can be seen clearly in Figure 1, which shows these series in nominal terms.) † Wood (1910a - e) 在研究十九世纪工资的统计数据时，使用主要来源编制了十九世纪棉花行业工资和就业的系列数据。Wood 的系列，包括对工厂工人和织布工的单独估计。他的完整系列从1806年到1862年，每年都有（Wood 1910e，第598-99页，表41）。Wood发现，织布工的每周名义工资从1806年的240天（旧便士），稳步下降到1820年的99天。同期，工厂工人的工资稳定在120天左右。（相对工资的变化可以在图 1中清楚地看到，该图以名义值显示了这些序列。）

These headline numbers need to be interpreted with care, for the following reasons. First, handloom workers were paid on a piece-rate basis. Those rates are known, but output (i.e., productivity) varied

²¹These numbers are frequently quoted and seem to originate from the reports of the handloom weavers commission, specifically those produced in 1840. They are also reported by Baines [2015 (1835), pp. 235 - 37], Chapman (1904, p. 28), and Hammond & Hammond (1919, p. 72) (see also Landes 2003). Baines [2015 (1835)] provides some additional commentary and context regarding this increase. He notes that by 1833 there were at least 100,000 power looms in operation in Britain, and the years of 1824 and 1825 were those of the greatest rise. Despite this increase in power looms, there remained many handloom weavers, their numbers rising from 240,000 in 1820 to 250,000 in 1834. † 这些数字经常被引用，似乎来源于手织织布工的报告委员会，特别是1840年生产的那些。Baines 也报道了这些现象[2015 (1835)，第235-37页]，Chapman (1904年，第28页)和 Hammond & Hammond (1919年，第72页)（另见Landes 2003年）。Baines[2015 (1835)]就这一增长，提供了一些额外的评论和背景。他指出，到1833年英国至少有10万台动力织机在运行，1824年和1825年是增长最快的年份。尽管动力织机有所增加，但仍有许多织布工，他们的数量从1820年的24万，增加到1834年的25万。

by worker, so total income varied a great deal across people (Bythell 1969). The piece-rate data show considerable variation during the year and across years as well as between re-gions (transportation costs were high before railways). However, the series in Figure 2 for muslin cloth at Bolton (north of Manchester) in 1795 - 1820 is consistent with the broader picture painted by modern authorities, such as Bythell (1969), as well as historians with access to a full range of evidence, most notably Hammond & Hammond (1919).²² These prices are in nominal terms and show an unmistakable decline after 1800. † 这些标题数字需要谨慎解读, 原因如下。首先, 手织工人按件计酬。这些比率是已知的, 但产出(即生产率)因工人而异, 因此人们的总收入差异很大 (Bythell 1969)。这个计件率数据显示, 在一年中、几年之间以及地区之间, 存在相当大的差异(铁路之前的运输成本很高)。然而, 图 2 中, 1795年至1820年 Bolton (曼彻斯特北部) 的棉布系列与Bythell (1969 年) 等现代权威, 以及能够获得全方位证据的历史学家(最著名的是 Hammond & Hammond (1919年)) 所描绘的更广泛的图景, 是一致的。这些价格是名义价格, 1800年后明显下降。

Second, as piece-rates fell, it is possible that output per worker increased, as the qualitative evidence suggests they worked harder (Bythell 1969, p. 116). It has been suggested that in their golden age (1780 - 1800), weavers worked 4 days per week and earned 40 shillings; by the 1830s, the general perception is that they were working harder, perhaps 14 - 16 hours per day for 6 days per week, and earning a lot less money per week or month or year.²³ † 其次, 随着计件工资的下降, 每名工人的产出可能会增加, 因为定性证据表明, 他们工作更努力 (Bythell 1969, 第116页)。有人认为, 在他们的黄金时代 (1780-1800), 织布工每周工作4天, 赚40先令; 到19世纪30年代, 人们普遍认为他们工作更努力, 可能每周工作6天, 每天工作14-16小时, 每周、每月或每年赚的钱, 要少得多。

Table 1 depicts estimated family earnings for handloom weavers in two Lancashire towns, starting in 1814. This series shows shillings per week alongside two measures of cost: the cost of keeping looms in good repair and household expenses (food, clothing, and rent). Column 1 shows that from 1814 to 1819, nominal weekly earnings for a family of six fell by half. Column 3 (“Leaving for other costs”) clearly shows the squeeze on handloom worker nominal earnings from 1814 to 1820 and confirms that this measure of earnings continued to fall through the 1820s and into the 1830s (see the next section for more details on real wages).²⁴ † 表 1描述了, 估计的从1814年开始, Lancashire 两个城镇手织织布工的家庭收入。本系列显示了每周的先令以及两个成本指标: 保持织机良好维修的成本和家庭开支(食物、衣服和租金)。第1列显示, 从1814年到1819年, 一个六口之家的名义周收入下降了一半。第3列(“为其他成本而离开”)清楚地显示了1814年至1820年间手织机工人名义收入的挤压, 并证实了这一收入指标, 在19世纪20年代和30年代继续下降(有关实际工资的更多详细信息, 请参阅下一

²²Muslin is a loosely woven cotton cloth. † Muslin 是一种编织松散的棉布。

²³Bythell (1969, p. 116) does not give a weekly earnings number for the 1830s, but the weekly wage for handloom weavers was 240d (or 20 shillings) in 1806 and only 75d in 1830, according to Wood (1910e, table 41), cited above. † Bythell (1969, 第116页) 没有给出19世纪30年代的每周收入数字, 但根据 Wood (1910e, 表41) 的数据, 1806年织布工的每周工资为240天(或20先令), 1830年仅为75天。

²⁴Even on the most positive interpretation, this period of wage decline for handloom workers is on the upper end of “an average working lifetime,” the transition period suggested by Mokyr et al. (2015) for higher productivity to be reflected in higher wages for laborers. On the other hand, it is possible that economy-wide wages turned upward a bit earlier; the precise timing of changing real wages in the 1830s for other parts of the economy is harder to discern. † 即使在最积极的解释中, 手织工人的工资下降期, 也处于“平均工作寿命”的上限, Mokyr等人(2015)建议的过渡期更高生产率将反映在劳动者的更高工资中。另一方面, 整个经济工资可能提前一点回升; 19世纪30年代, 其他经济部门实际工资发生变化的确切时间, 更难辨别。

节)。

Hammond & Hammond (1919), among others, were confident that **handloom** weavers lived well at the end of the 1700s and that most people engaged in the same occupation were quite poor in the 1830s (and likely by 1820). This is also the overwhelming assessment of various parliamentary investigations, including the highly informative 1835 Parliamentary Select Committee report (G.B. Parliam. 1835). † Hammond & Hammond (1919) 等人相信, 18世纪末, 织布工生活得很好, 从事同一职业的大多数人, 在19世纪30年代(可能到1820年)都很穷。这也是对各种议会调查的压倒性评估, 包括1835年议会特别委员会信息量很大的报告(G.B.Parliam.1835)。

A third reason to interpret the data series with caution is that the 1835 parliamentary report and other official investigations arose because weavers were petitioning for government action in their favor, so there may have been some natural inclination to exaggerate their difficulties (Bythell 1969, p. 114). However, Hammond & Hammond (1919) provide corroborating evidence from a wide range of people, including some not at all sympathetic to the workers.²⁵ † 谨慎解释数据系列的第三个原因是, 1835年的议会报告和其他官方调查, 是因为织布工请求政府采取有利于他们的行动而产生的, 因此, 可能有一些夸大他们困难的自然倾向(Bythell 1969, 第114页)。然而, Hammond & Hammond (1919) 提供了来自广泛人群的确凿证据, 其中包括一些根本不同情工人的人。

In Bythell' s (1969, pp. 106 - 7) summary, “the decline in money wage rates for **handloom** weaving between the 1790s and the 1830s was spectacular.”²⁶ † 在Bythell (1969年, 第106-7页) 的总结中, “18世纪90年代至19世纪30年代, 纺织业货币工资率的下降太壮观了。”

In sum, there is considerable evidence consistent with Wood' s wage series, showing a decline in nominal **wages** for **handloom** workers in the cotton industry, with little offset in the form of new opportunities in factories. 总之, 有相当多的证据与 Wood 的工资序列相一致, 表明, 棉花行业**手工织机**工人的名义**工资**下降, 几乎没有以工厂新机会的形式抵消。

§4.2.2 Real **wages** † 实际工资

The evolution of consumer prices in this period has central importance to the broader question of how economy-wide real wages evolved in this time, and it has been contentiously debated for decades. As discussed in the **Supplemental Appendix**, this debate has settled down (at least until any new data make an appearance). While there have been several twists and turns, Allen (2007, 2009) offers a sensible reconciliation of the plausible alternative views, favoring an index that is close to the work of Feinstein (1998a,b), but with some modifications suggested by Clark (2005).²⁷ Consumer prices (for a

²⁵Readers may consult, for example, G.B. Parliam. (1835). † 例如, 读者可以查阅 G.B.Parliam。(1835)。

²⁶Hunt (1981) has a more positive view of **wages** during the early Industrial Revolution than the more recently available data suggest. Nevertheless, our view on what happened to **handloom** weavers aligns with his: “But it was the mechanization of cotton spinning and the increased output of machine-spun yarn that had initially raised hand-loom weavers' earnings to as much as 40s a week and persuaded large numbers to take up the loom, and it was effective mechanization of weaving after 1820 that most decisively forced down **wages**” (Hunt 1981, p. 64). † Hunt (1981) 对工业革命早期的**wages**的看法, 比最近可用的数据更为积极。然而, 我们对**手织**织布工发生的事情的看法, 与他的观点一致: “但正是棉纺的机械化和机器纺纱产量的增加, 最初将手织机织布工的收入, 提高到每周40多美元, 并说服了大量人使用织布机, 而1820年后有效的织布机械化, 最果断地迫使工资下降” (Hunt 1981, 第64页)。

²⁷Clark makes some updates to his index (Clark 2007, 2010) but does not address important detailed critiques by Allen (2007). Details of Allen's arguments are covered in the **Supplemental Appendix**. We use Clark's latest available

basket of typical working-class consumption) rose by about 10% between the early 1800s and the early-to mid-1820s (Allen 2007). † 这一时期消费价格的演变，具有核心意义，这一时期，整个经济体的实际工资是如何演变的，这是一个争论了几十年的更广泛的问题。如补充附录所述，这场辩论稳定下来（至少在任何新数据出现之前）。虽然有一些曲折反过来，Allen（2007, 2009）对看似合理的替代观点进行了合理的调和，倾向于使用与 Feinstein（1998a, b）的工作接近但经过一些修改的指数拉克（2005）提出。消费者价格（针对一篮子典型的工薪阶层消费），从19世纪初到19世纪20年代初到中期，这一数字上升了约 10%（Allen 2007）。

Consequently, real wages for **handloom** weavers fell in this period, likely declining to around 25% of their peak golden-age level—and then slumped further (Figure 3).²⁸ † 因此，**手织机**织布工的实际工资，在此期间下降，可能降至约其黄金年龄峰值的25%，然后进一步下跌（图 3）。

Supporting evidence on this point comes from the 1835 Parliamentary Select Committee. The committee interviewed and received testimony from various weavers, manufacturers, and others with direct experience in the textile industry. These sources report consistently poor and deteriorating living conditions among weavers throughout Britain. They confirm **wages** fell since at least 1800 and summarize the increased poverty in terms of the basket of goods that weavers could afford. † 关于这一点的支持性证据，来自1835年的议会特别委员会。委员会采访了各种织布工、制造商和其他在纺织业有直接经验的人，并听取了他们的证词。这些消息来源报告称，英国各地织布工的生活条件一直很差，而且不断恶化。他们证实**工资**至少自1800年以来有所下降，并从织布工能够负担得起的一篮子商品的角度总结了贫困的加剧。

The units—pounds of food (flour, oatmeal, potatoes, and “butcher’s meat”)—that could be afforded are not standard in modern economics. They are nonetheless highly informative. For example, an income of nearly 27 shillings per week in 1797 - 1804 could purchase 100 lbs of flour, 142 lbs of oatmeal, 826 lbs of potatoes, or 55 lbs of butchers’ meat, which yields an average of 281 lbs. (G.B. Parliam. 1835, p. xiii). By 1818 - 1825 this sum had more than halved to only 103 lbs. This confirms that the purchasing power of **handloom** weavers collapsed immediately before and during the time when Ricardo was revising his views on machinery. (The **Supplemental Appendix** provides further corroborating details from more standard and comprehensive consumer price indices.) † 可以负担的单位——磅食物（面粉、燕麦片、土豆和“肉铺”）——在现代经济学中不是标准的。尽管如此，它们还是提供了丰富的信息。例如，1797年至1804年，每周近27先令的收入可以购买100磅面粉、142磅燕麦片、826磅土豆或55磅屠夫肉，平均产量为281磅（G.B.Parliam.1835, p.xiii）。到1818年至1825年，这一数字减少了一半以上，仅为103磅。这证实了，**手织机**织布工的购买力，在 Ricard 修改其对机械的看法之前和期间，立即崩溃。（补充附录根据更多标准和全面的消费者价格指数，提供进一步佐证细节。）

index in all figures that refer to Clark (2010). † Clark 对他的指数进行了一些更新（Clark 20072010），但没有回应 Allen（2007）的重要详细批评。Allen 的论点细节见补充附录。在所有涉及 Clark（2010）的图中，我们使用 Clark 的最新可用指数。

²⁸As discussed in the **Supplemental Appendix**, Allen and Clark offer the two leading consumer price indices for this period, with some differences between them. However, our core statements about what happened to the real **wages** of cotton workers are robust to the choice between these two price indices. † 正如补充附录中所讨论的，Allen 和 Clark 提供了这一时期的两个主要消费者价格指数，但它们之间存在一些差异。然而，我们关于棉花工人的实际工资发生了什么的核心陈述，对这两个价格指数之间的选择，是稳健的。

When it was clear that their earnings had fallen and would not recover, why didn't **handloom** workers move to other income-earning opportunities, for example, in cotton factories? Landes (2003, p. 86) comments that the slow decline in the number of **handloom** weavers “testified to the obstinacy and tenacity of men who were unwilling to trade their independence for the better-paid discipline of the sheds.” This may have been part of the explanation, but other opportunities were mostly lacking in Lancashire, where a disproportionate number of **handloom** workers were located, and even elsewhere in the country. There was no other booming sector, and in the first two decades of the nineteenth century, cotton factories did not expand fast enough to employ a large number of **handloom** workers. The most complementary activity to weaving, spinning, was already mechanized to a significant degree. As Bythell (1969, p. 107) puts it, “until the great expansion of all kinds of factory work in the cotton districts from the 1820s,” movement out of the **handloom** sector was slow.²⁹ † 当他们的收入明显下降、且不会恢复时，为什么不使用**手织**工人转移到其他创收的机会，例如棉纺厂？Landes（2003，第86页）评论说，**手织**机织布工数量的缓慢下降，“证明了不愿用独立换取更好的人的固执和坚韧-支付工棚纪律费。”这可能是部分原因，但也有其他机会 Lancashire 大部分地区都缺乏，那里有不成比例的**手织**工人位于，甚至在该国的其他地方。没有其他蓬勃发展的行业，在第一个19世纪20年代，棉纺厂的扩张速度不够快，无法雇佣大量的织布工。与织布、纺纱最互补的活动，已经在很大程度上实现了机械化。正如 Bythell（1969年，第107页）所说，“直到19世纪20年代，棉花区各种工厂工作的大规模扩张”，离开纺织业的行业，发展缓慢。

§4.2.3 Employment † 就业

In 1788, there were 60,000 people employed in spinning factories; there was no large-scale factory employment of weavers. There were, however, 108,000 people employed as **handloom** weavers (Table 2), most of whom worked either in their homes or in small workshops. In 1806, there were still few workers in cotton factory-based weaving, but this number reached 3,000 by 1813 and 10,000 by 1817 (see Figure 4 for the best available series). † 1788年，纺织厂雇佣了6万人；没有大规模的工厂雇佣织布工。然而，有10万8千人被聘为**手织**织布工（表2），其中大多数人要么在家里工作，要么在小作坊工作。1806年，棉纺厂织布的工人仍然很少，但到1813年，这一数字达到了3000人，到1817年达到了10000人（最佳系列见图4）。

Of the power loom, Landes [2003, p. 86; based on Baines 2015 (1835)] writes, “[W]here, in the first decade of the century, the machine worked hardly faster than the traditional **handloom**, the technical advantage had risen by the mid-1820's to as much as 7.5 to 1, and one boy on two looms could do up to fifteen times as much as the cottage artisan.” 关于动力织机，Landes [2003, 第86页；基于Baines 2015 (1835)]写道：“在本世纪的第一个十年，这台机器的工作速度，几乎不比传统的织布机快，到19世纪20年代中期，技术优势，已经上升到 7.5 : 1，一个男孩在两台织布机上可以做的事情，是手工艺人的 15 倍。”

As shown in Table 2, by 1820, the cotton industry employed 115,000 workers in spinning jobs and 11,000 in weaving jobs in factories. Total employment in the cotton industry (factory operatives plus **handloom** workers) rose from 168,000 in 1788 to 274,000 in 1806 and to 336,000 in 1820.³⁰ This change

²⁹ Presumably it was difficult to move back to agriculture, in part because enclosures had limited the amount of common land available. † 大概很难回到农业，部分原因是围栏限制了数量可用的公共土地。

³⁰ Bythell (1969, p. 54) cautions on early data quality; however, he also notes that “figures of the order of 200,000 to

in the structure of employment is consistent with data showing steady investment in British cotton-spinning mills during this period (Chapman 1987, p. 29, table 3). † 如表 2 所示, 到1820年, 棉花行业, 在工厂雇佣了11.5万名纺纱工人和1.1万名织布工人。棉花行业的总就业人数(工厂操作人员加手织机工人), 从1788年的168000人, 增加到1806年的274000人和1820年的336000人。就业结构的这种变化, 与这一时期英国棉纺厂稳定投资的数据, 是一致的(Chapman 1987, 第29页, 表3)。

In 1815, there were perhaps 200,000 **handloom** weavers, rising to 240,000 in 1820. † 1815年, 可能有200000名手织布工, 1820年增至240000名。³¹ There were still 200,000 - 250,000 **handloom** weavers in the early 1830s, according to various sources, including testimony to the 1835 Parliamentary Select Committee on weaving. 根据各种来源, 19世纪30年代初, 仍有20万至25万名手织布工, 包括1835年议会编织特别委员会的证词。³²

Power-loom weaving never employed anywhere near as many workers as did **handloom** weaving at its peak. There were perhaps 10,000 power-loom workers in factories in 1817 and only 11,000 in 1820. There were 107,000 factory operatives in 1813 compared with 212,000 **handloom** weavers. By 1819 - 1821, the total number of factory operatives was around 120,000, while the number of **handloom** weavers is estimated to have increased to 240,000.³³ 动力织机织造从未雇佣过像手织机织造高峰期那样多的工人。1817年, 工厂里可能有10000名动力织机工人, 1820年只有11000名。1813年, 工厂有107000名工人, 而织布工有212000名。到1819年至1821年, 工厂操作员的总数约为120000人, 而织布工的数量估计已增加到240000人。

Employment of **handloom** weavers perhaps was not the issue that attracted most attention. This was a sector with relatively low barriers to entry, and which generally did not need a great deal of skill or established expertise. Much more of the concern (including in the run-up to and aftermath from Peterloo) was about the steady decline in earnings and the standard of living for **handloom** weavers during the first two decades of the nineteenth century, as discussed above.

§4.3 Factory Operatives † 工厂操作员

As shown in Figure 3, from 1806 to 1818 - 1820 the real **wages** of cotton workers in factories barely increased, while there was a modest increase in employment in this activity. In 1806, 90,000 factory operatives earned a weekly wage of 121d, while in 1820, 126,000 workers earned 124d. In 1806, at the start of the available series, 184,000 **handloom** weavers earned roughly double (240d) what cotton

250,000 will not over-represent the total number of hand-loom weavers when the labor force was at its peak” (p. 57). † Bythell (1969, 第54页) 对早期数据质量的警告; 然而, 他也指出, “20万至25万的数字, 不会超过劳动力高峰期手织布工的总数” (第57页)。

³¹The number of **handloom** weavers rose steadily from 1788 to 1820; 240,000 was peak employment, a level that was maintained until 1831 according to Wood (1910e, p. 596, table 40).

³²While the available data do not reach modern standards of quality, this industry was investigated repeatedly by parliamentary committees. These investigations are the source for much of the information used by Baines [2015 (1835)] and Wood (1910a - e). Hammond & Hammond (1919) used a wider range of materials, mostly communications between the government (in London) and local informants and magistrates. Thus, even though the data are far from perfect, several independent sources confirm the basic patterns. † 虽然现有数据, 未达到现代质量标准, 但议会委员会对该行业进行了反复调查。这些调查是Baines [2015 (1835)]和 Wood (1910a - e) 使用的大部分信息的来源。Hammond & Hammond (1919) 使用了更广泛的材料, 主要是政府(伦敦)与当地线人和地方法官之间的沟通。因此, 尽管数据远非完美, 但几个独立的来源证实了基本模式。

³³There may have been another 50,000 people employed as auxiliaries to **handloom** weavers (Chapman 1987, p. 51).

factory workers were paid. Up until 1815, **handloom** weavers earned more than factory operatives, but then this changed quite dramatically. By 1820, **handloom** weavers earned more than 25% less than factory operatives—and this gap only grew over time. † 如图 3 所示, 从 1806 年到 1818-1820 年, 工厂棉花工人的实际工资, 几乎没有增长, 而这一活动的就业人数, 略有增加。1806 年, 90000 名工厂工人的周薪为 121 天, 而 1820 年, 126000 名工人的周酬为 124 天。1806 年, 在可用系列的开始, 184000 名手织布工的收入, 大约是棉纺厂工人工资的两倍 (240 天)。直到 1815 年, 手织布工的收入, 都高于工厂工人, 但后来, 情况发生了很大变化。到 1820 年, 织布工的收入比工厂工人低 25% 以上, 而且这一差距, 只会随着时间的推移而扩大。

Taking a weighted average across the cotton industry, all work people earned 200d per week in 1806, falling to 150d in 1815, and to only 108d in 1820. ³⁴ Over the same decade and a half, **productivity** gains, including with the spread of steam power, continued to be remarkable. The population of some textile towns in the Greater Manchester area more than doubled between 1801 and 1831. ³⁵ † 以整个棉花行业的加权平均值来看, 1806 年, 所有工人每周的收入为 200 天, 1815 年, 降至 150 天, 1820 年, 降至 108 天。在同样的十五年里, **生产率** 的增长, 包括蒸汽动力的普及, 仍然显著。1801 年至 1831 年间, 大曼彻斯特地区, 一些纺织城镇的人口, 翻了一番多。

In real terms, using Allen's (2007) consumer price index for reasons discussed in the Supplemental Appendix, earnings fell significantly (by more than half) for **handloom** workers between 1806 and 1820, but real **wages** also declined (by about 10%) for cotton factory operatives. ³⁶ The weighted average wage in this highly productive and rapidly innovating sector fell by about 50% from 1806 to 1820. Compared to the golden age that ended around 1800, earnings for **handloom** weavers fell to about one-quarter of their previous level. ³⁷ Despite being a highly productive, modern, and growing industry, manufacturing cotton by 1820 was significantly less remunerative for its labor force than had been the case 20 - 30 years earlier. † 按实际价值计算, 用补充附录中讨论的原因, 用 Allen (2007) 消费者价格指数, 1806 年至 1820 年间, 手织工人的收入, 大幅下降 (下降了一半以上), 但棉纺厂操作员的实际工资, 也下降了 (约 10%)。从 1806 年到 1820 年, 这个生产力高、创新快的行业的加权平均工资, 下降了约 50%。与 1800 年左右结束的黄金时代相比, 手织布工的收入, 降至之前水平的四分之

³⁴We calculate the weighted average wage as (number of factory operatives × factory wage) + (number of **handloom** weavers × **handloom** earnings), divided by the total number of workers in this sector for that year. † 我们计算加权平均工资为: [(工厂操作人员人数 × 工厂工资) + (手织布工人数 × 手织布机收入)] / (该部门当年的工人总数)。

³⁵The population of Bradford rose from 29,000 to 77,000, while Huddersfield increased from 15,000 to 34,000 residents, and Leeds from 53,000 to 123,000 (Finer 2017). Sanitation did not keep pace, and the public health consequences were dire: “There were parts of Manchester where thirty-three privies had to supply 7,095 persons” (Finer 2017, p. 215). Mortality rate (deaths per 1,000) increased from the 1820s. † Bradford 的人口, 从 29000 人增加到 77000 人, Huddersfield 的居民, 从 15000 人增加到 34000 人, Leeds 居民从 53000 人增加到 123000 人 (Finer 2017)。卫生设施没有跟上步伐, 公共卫生后果是可怕的: “曼彻斯特的部分地区有 33 个厕所必须为 7095 人提供服务” (Finer 2017, 第 215 页)。死亡率 (每千人死亡人数) 从 19 世纪 20 年代开始上升。

³⁶**Handloom** workers were paid piece-rates, which varied considerably from year to year. Factory operatives were paid a fixed nominal wage, with no indexation or adjustment for inflation, so their standard of living was squeezed whenever the price level rose. As shown in Figure 3, our findings are robust across choice of price index. † 手织工人的计件工资, 每年都有很大差异。工厂操作人员, 他们的名义工资是固定的, 没有指数化或通货膨胀调整, 因此只要物价水平上涨, 他们的生活水平就会受到挤压。如图 3 所示, 我们的发现, 在价格指数的选择上是稳健的。

³⁷In contrast, many employers did well. There is no complete series on profits, but Hobsbawm (1996) provides some convincing numbers and details on this point. † 相比之下, 许多雇主表现良好。没有关于利润的完整系列, 但 Hobsbawm (1996) 在这一点上提供了一些令人信服的数字和细节。

一左右。尽管棉花是一个生产力高、现代化和不断发展的行业，但到1820年，棉花制造业对劳动力的报酬明显低于20-30年前。

This would be less of a concern, perhaps, if real **wages** and employment had grown elsewhere in the economy. While the evidence is not perfect, the data strongly suggest that economy-wide real **wages** were largely flat from the end of the 1700s to 1820, and in fact, real **wages** declined in sectors where **productivity** rose most notably. This continued well into the 1820s and likely did not turn around until sometime in the 1830s (the leading economy-wide wage series are shown in Figure 5).³⁸ † 如果实际**工资**和经济其他领域的就业，有所增长，这可能就不那么令人担忧了。虽然证据并不完美，但数据强烈表明，从18世纪末到1820年，整个经济体的实际工资基本持平，事实上，实际工资，在生产率增长最显著的部门，有所下降。这种情况，一直持续到19世纪20年代，可能直到19世纪30年代才有所好转（整个经济体的主要工资序列，如图 5 所示）。

§4.4 Prominent Sectors and Economy-Wide **Wages** † 主要行业和整个经济体的工资

The positive effect of **productivity** increases on **wages** may be apparent outside of the sector where technological progress is most concentrated. This could be because the innovating sector provides cheaper goods to the rest of the economy—indeed, the price of cotton clothing did fall. If the labor market is competitive and the cost of mobility across occupations and geographies is low, **wages** should also tend to equilibrate. † 生产率的提高，对**工资**的积极影响，可能在技术进步最集中的部门之外很明显。这可能是因为，创新部门为经济的其他部门提供了更便宜的商品—事实上，棉质服装的价格确实下降了。如果劳动力市场具有竞争力，跨职业和地域的流动成本较低，**工资**也应趋于平衡。

Coal mining was a relatively well-developed sector by 1800, including with the use of steam engines to pump water from great depths.³⁹ We also have a great deal of regional data on miners' **wages**.

³⁸Kelly et al. (2023) propose an economy-wide measure based on agricultural **wages**, adjusted for changes in population by county. For 1770 to 1833 (the dates they specify), the increase in real **wages** was 8% (using Allen prices) or 13% (using Clark prices). However, over the same period, the increase in real **wages** was 21% if we use Feinstein's economy-wide wage estimate or 40% using Clark's economy-wide wage series, as shown in Figure 5. This long-difference calculation is interesting but does not highlight a major point of agreement: There was little if any increase in economy-wide real **wages** until well into the 1810s (Clark's version) or even the mid-late 1820s (using the Feinstein or Allen series). We should note that there is also widespread agreement, or perhaps even a consensus, that real **wages** grew steadily from the mid- or late-1830s. However, as Mokyr (2009) emphasizes, living conditions in cities were bad and perhaps even worsened (e.g., with cholera, typhus, and other disease burdens increasing) until at least the 1850s. † Kelly 等人 (2023) 提出了一种基于农业**工资**的全经济指标，并根据各县人口变化进行了调整。1770年至1833年（他们指定的日期），real**wages**的增长率为8%（使用艾伦价格）或13%（使用克拉克价格）。然而，在同一时期，如果我们使用范斯坦的全经济工资估算，实际工资增长率为21%，如果使用克拉克的全经济薪资序列，实际工资上涨率为40%，如图 5 所示。这种长期差异计算很有趣，但并没有突出一个主要的共识点：直到19世纪10年代（克拉克的版本）甚至19世纪20年代中后期（使用 Feinstein 或 Allen 级数），整个经济体的实际工资，几乎没有增加。我们应该注意到，也有广泛的共识，甚至可能是共识，即实际**工资**，从1830年代中后期开始稳步增长。然而，正如 Mokyr (2009) 强调的那样，至少在19世纪50年代之前，城市的生活条件很差，甚至可能恶化（例如，霍乱、斑疹伤寒和其他疾病负担增加）。

³⁹The coal industry was developed primarily to supply fuel to households. The London area was substantially deforested by the 1600s, and bringing wood to the city was expensive. By 1800, there were some industrial uses, but the spread of steam engines started to have major effects—including by allowing large urban agglomerations to develop—only after that date. By the time Ricardo was writing, commercially viable steam locomotion on iron railways still seemed to be a pipe dream. The Rainhill trials of 1829 and the success of the Liverpool and Manchester Railway, which opened in 1830, changed everything (Acemoglu & Johnson 2023, chapter 5). † 煤炭工业的发展，主要是为了向家庭供应燃料。到17世纪，伦敦地区的森林被大量砍伐，将木材运到城市是昂贵的。到1800年，有一些工业用途，但蒸汽机的传播，开始产生重

Table 3 shows that nominal daily miner **wages** in Northumberland, for example, were under 3 shillings in 1800 - 1802, rising above 3 shillings in 1813 - 1814, but then falling back to (or below) the 1800 level by 1822. There is a similar pattern in other regions, including in Lancashire and Cheshire, which had important coal fields at this time. A miner earned the same nominal wage in 1800 and in 1822, according to this series. † 到1800年, 煤炭开采是一个相对发达的行业, 包括使用蒸汽机从深处抽水。我们还有大量关于矿工**工资**的区域数据。例如, 表 3显示, 诺森伯兰郡的名义日矿工**wages**在1800-1802年低于3先令, 在1813-1814年高于3先令, 但到1822年回落到(或低于)1800年的水平。其他地区也有类似的模式, 包括 Lancashire 和 Cheshire, 这些地区当时有重要的煤田。根据这一系列数据, 1800年和1822年, 矿工的名义工资相同。

Table 4 confirms this account with decadal averages for builders' **wages**, broken down by crafts-men (more skilled workers) and helpers (less skilled), from Clark (2005, 2007). There was not much increase through the mid-1750s, but clearly some increase in nominal **wages** appeared after 1779. The decadal average nature of this series makes it hard to see the precise timing, but it seems clear that nominal **wages** for both categories of builders increased in the first two decades of the nineteenth century. † 表 4 用 Clark (2005, 2007) 的建筑工人**工资**的十年平均值, 证实了这一说法, 并按工匠(技术含量较高的工人)和助手(技术含量较低的工人)进行了细分。到1750年代中期, 工资并没有太大增长, 但很明显, 1779年之后, 名义**工资**出现了一些增长。这一系列的十年平均性质, 使得很难看到确切的时间, 但很明显, 两类建筑商的名义**工资**, 在十九世纪前二十年都有所增加。

Table 4 confirms a similar pattern for agricultural **wages**, also from Clark (2005, 2007). In real terms these rose and fell with harvest and trade conditions but only roughly kept up with inflation during the early Industrial Revolution. † 表 4 证实了农业**工资**的类似模式, 同样来自 Clark (2005, 2007)。按实际价值计算, 这些价格, 随着收成、贸易条件的变化而上涨和下跌, 但在工业革命早期, 仅大致跟上了通货膨胀的步伐。

Some sectors, including coal mining, expanded rapidly in the early nineteenth century but, like cotton weaving, relied on low-wage labor from children and women. The macro picture for the British economy during this era is one in which output and employment increased across a wide range of sectors, and there was no mass unemployment. The percentage of people employed in agriculture fell, as workers were absorbed into expanding sectors. Nevertheless, until the railway system began to develop in the 1830s, sectors that were developing and introducing new machinery most rapidly, such as the cotton industry and coal mining, did not pay commensurately high **wages**.⁴⁰ † 包括煤矿在内的一些行业, 在19世纪初迅速扩张, 但像织布一样, 依赖儿童和妇女的低薪劳动力。这一时期英国经济的宏观形大影响, 包括允许大型城市群发展, 直到那一天之后。在 Ricardo 写作的时候, 在铁路、商业上, 可行的蒸汽动力似乎仍然是一个白日梦。1829 年的 Rainhill 试验和1830年开通的利物浦和曼彻斯特铁路的成功, 改变了一切 (Acemoglu & Johnson 2023, 第5章)。

⁴⁰This is consistent with work by Mokyr (1988), who finds only slow consumption growth (under half a percent per year) from 1815 to 1849, roughly, with most of the growth occurring later in this period (for the broader context see Mokyr 2009, particularly chapter 18). Mokyr emphasizes that there were a series of negative shocks to living standards at this time, including in the short run from the Napoleonic Wars' impact on grain prices and from bad weather, and in the longer run from the unprecedented increase in population. † 这与 Mokyr (1988) 的工作是一致的, 他发现1815年至1849年的消费, 增长缓慢(每年不到0.5%), 大致上, 大部分增长, 发生在这一时期的后期(更广泛的背景见 Mokyr 2009, 特别是第18章)。Mokyr 强调, 当时生活标准, 受到了一系列负面冲击, 包括拿破仑战争对粮食价格和恶劣天气的短期影响, 以及从长远来看, 前所未有的口增长。

势是，各部门的产出和就业都有所增加，没有大规模失业。随着工人被吸收到不断扩大的部门，农业就业人数的比例下降。然而，在19世纪30年代铁路系统开始发展之前，棉花工业、煤矿等开发和引进新机械最快的行业，并没有支付相应的高工资。

Consistent with the evidence from individual industries, economy-wide real **wages** stagnated through the early nineteenth century. Figure 5 shows the best available overall real wage series and the effects of using alternative price indices. † 与个别行业的证据一致，整个经济体的实际**工资**，在19世纪初停滞不前。图 5 显示了可用的最佳整体实际**工资**序列，以及使用替代价格指数的效果。

Using Allen’s preferred index (or anything close to it), economy-wide real **wages** did not rise much, if at all, in the early 1800s. In cotton textiles, the most rapidly innovating sector, real **wages** declined sharply. † 使用艾伦的首选指数（或任何接近它的指数），19世纪初，整个经济体的实际**工资**，并没有大幅上涨。在创新最快的棉纺织行业，实际**工资**急剧下降。

Note that real **wages** fluctuated significantly as nominal **wages** were sticky and prices moved a great deal. The evaluation of change in real **wages** is affected by end points (e.g., real **wages** in 1821 were above their 1819 level, due to lower prices). However, real **wages** did not significantly break with their previous trend until well into the 1830s, according to Allen and Feinstein. † 请注意，由于名义**工资**具有粘性，价格变动很大，因此，实际**工资**波动很大。对实际**工资**变化的评估受到终点的影响（例如，由于价格下跌，1821年实际**工资**高于1819年的水平）。然而，根据 Allen 和 Feinstein 的研究，直到19世纪30年代，实际**工资**才与之前的趋势，发生显著变化。

As we discuss in the **Supplemental Appendix**, Clark (2005, 2007, 2010) offers an alternative price series for the early 1800s. Using this index, the implications for economy-wide **wages** are more positive, as recently emphasized by Kelly et al. (2023). † 正如我们在**补充附录**中讨论的那样，Clark (2005, 2007, 2010) 为19世纪初提供了一个替代价格系列。正如 Kelly 等人 (2023) 最近强调的那样，使用该指数对整个经济体的**工资**的影响，更为积极。⁴¹

§4.5 Assessment † 评估

The data discussed above suggest that Ricardo had good reason to become more cautious about the effects of machinery on labor. Like spinning machinery previously, the power loom boosted **productivity** in weaving. As new machines replaced people in weaving tasks, some additional jobs were created — for example, tending to those machines, including repairing them as needed. However, the number of new jobs created in weaving did not match the displacement of opportunity for human **handloom** workers. † 上述数据表明，Ricardo 有充分的理由对机器对劳动力的影响，更加谨慎。与之前的纺纱机械一样，动力织机提高了织造的生产力。随着新机器取代了织布任务中的人，创造了一些额外的工作岗位，例

⁴¹Clark (2001) reaches a more positive assessment of real **wages** in the early Industrial Revolution when he uses his price index and his own agricultural wage series, which is available for four regions. Kelly et al. (2023) have a similar view of economy-wide **wages** based on Clark’s price index and wage data from Hunt (1986), which are based on Bowley (1898). We prefer Allen’s price index for the detailed reasons given in the **Supplemental Appendix**, but the door is always open to new data that may speak to this issue. Kelly et al. (2023) find that agricultural **wages** rose in the north relative to the south when comparing 1770 to 1860. † Clark (2001) 使用他的价格指数、和他自己的农业工资系列（可用于四个地区），对工业革命早期的实际**工资**做出了更积极的评价。Kelly 等人 (2023) 基于 Clark 的价格指数和 Hunt (1986) 的基于 Bowley (1898) 的工资数据，对整个经济体**工资**得到类似的看法。由于**补充附录**中给出的详细原因，我们更喜欢 Allen 的价格指数，但大门始终对可能解决这个问题的新数据敞开。Kelly 等人 (2023) 发现，与1770年和1860年相比，北方的农业**工资**相对于南方，有所上升。

如，照料这些机器，包括根据需要进行维修。然而，制造业创造的新工作岗位数量，与人力纺织工人的机会转移，并不匹配。

The main complementary activity, spinning, was already highly mechanized. Other sectors were not stimulated enough, either directly by the lower cost of woven cloth or indirectly through gains to consumers (for whom clothing was a small part of their spending; see the **Supplemental Appendix**.) † 主要的补充活动，纺纱，已经高度机械化了。其他行业没有得到足够的刺激，无论是直接受到织布成本降低的刺激，还是间接通过消费者的收益（对他们来说，服装只是他们支出的一小部分；见补充附录。）

In a modern industrialized economy, we expect more innovative sectors (such as software or biotech today) to pay high wages. The reality in Lancashire in the early 1800s was more complex. Real wages for handloom workers fell sharply, and the average real wage for the cotton industry (weighted across handloom factory workers) did not rise for many decades (Figure 3). Successful entrepreneurs earned huge profits from applying new machines, but this prosperity was barely shared with any workers; even cotton factory workers saw little increase in their real wage from around 1820 until about 1850. † 在现代工业化经济中，我们预计更多的创新部门（如今天的软件或生物技术）将支付高工资。19世纪初，Lancashire 的现实情况更为复杂。手织织布工人的实际工资，大幅下降，棉花行业的平均实际工资（用手织工厂工人加权），几十年来没有上升（图 3 ）。成功的企业家，通过应用新机器获得了巨额利润，但这种繁荣，几乎没有与任何工人分享；从1820年左右到1850年左右，就连棉纺厂工人的实际工资也几乎没有增长。

Productivity gains due to new machinery in cotton were not shared with the workers in textile production, nor were there compensatory gains in other sectors of employment. Economy-wide real wages rose little or stagnated (depending on the dates chosen for comparisons), and there is little evidence of growth in other low-skilled occupations such as building, farming, or mining. † 纺织生产中的工人，没有分享棉花新机械带来的生产率收益，其他就业部门，也没有补偿收益。整个经济体的实际工资，几乎没有增长或停滞不前（取决于选择的比较日期），建筑、农业或采矿等其他低技能职业，也几乎没有增长的证据。

Although the issue of earnings is crucial, it partly misses how industrialization upended the social lives of workers. As Hobsbawm (1999) notes in *Industry and Empire*, the Industrial Revolution was just as much a social revolution as it was an economic one. Understanding the consequences of this social upheaval is central to the question of how new technologies impacted laborers' lives. † 尽管收入问题至关重要，但它在一定程度上，忽略了工业化是如何颠覆工人的社会生活的。正如 Hobsbawm (1999) 在《工业与帝国》中指出的那样，工业革命既是一场经济革命，也是一场社会革命。了解这场社会动荡的核心问题，是新技术如何影响劳动者生活。

§5 WORKING AND LIVING CONDITIONS † 工作和生活条件

Ricardo was primarily focused on the efficiency improvements of adopting machines. He and other leading early economists tended to neglect or play down other considerations, including the issue of power in the workplace—which is important in its own right but also influences whether workers get a fair share. † Ricardo 主要致力于提高采用机器的效率。他和其他早期领先的经济学家，倾向于忽视

或淡化其他考虑因素，包括工作场所的权力问题——这本身就很重要，但也会影响工人是否得到公平的份额。

E.P. Thompson's *The Making of the English Working Class*, with its emphasis on working conditions, offers a helpful corrective (Thompson 1966). Multiple original sources agree that [handloom](#) workers had considerable control over when and how hard they worked on particular days or during the year. All of this disappeared as tasks were taken over by weaving machines. This not only was impoverishing, as Ricardo came to understand, but also fundamentally changed the balance of power between employers and workers. † E.P. Thompson 《英国工人阶级的形成》强调工作条件，提供了一种有益的纠正 (Thompson 1966)。多个原始来源一致认为，[手织](#)工人对他们在特定日子或一年中的工作时间和努力程度，有相当大的控制权。随着织布机接管任务，所有这些都消失了。正如 Ricardo 所理解的那样，这不仅导致了贫困，而且从根本上改变了雇主和工人之间的权力平衡。

We should not idealize what came before large factories. Nevertheless, it seems clear that some weavers had much greater autonomy and control over their schedule and craft in the mid- or even late-1700s. In fact, in some ways they were more like independent business people than workers. They were referred to as selling their cloth, not their labor (Chapman 1904), and even when they worked at home for large merchants, who would supply cloth and rent machines, there were alternatives. In contrast, contemporary sources report that there was a de facto “combination” by factory owners, with an agreement not to hire workers who quit other employers in the same area. There was no government enforcement of combination laws when it came to employers. † 我们不应该把大工厂之前的东西理想化。然而，很明显，在1700年代中期甚至后期，一些织布工，对他们的日程和工艺，有更大的自主权和控制权。事实上，在某些方面，他们更像是独立的商人，而不是工人。他们被称为卖布料，而不是劳动力 (Chapman 1904)，即使当他们在家为大商人工作时，他们也会提供布料和租用机器，还有其他选择。相比之下，当代消息来源报道称，工厂主事实上是“联合”的，他们同意不雇佣，在同一地区辞职的工人。在雇主方面，政府没有执行合并法。

As weaving became automated, deskilling accompanied disempowerment of the workers. Machines effectively replaced skilled and experienced adult men with women and children, who had less skill and who were also cheaper and easier to control. This reinforced the significantly declining ability of weavers to have a say in their working conditions or the discipline to which they were subjected, and, consequently, control over daily life passed into the hands of employers (see Hammond & Hammond 1919 for further discussion). Of course, this also meant that they had less say in the determination of their pay. † 随着织布变得自动化，去技能化，伴随着工人的权力被剥夺。机器有效地用妇女和儿童取代了技术熟练、经验丰富的成年男子，这些妇女和儿童技能较低，也更便宜、更容易控制。这加剧了织布工在工作条件或所受纪律方面的发言权的显著下降，因此，对日常生活的控制权转移到了雇主手中（进一步讨论见Hammond & Hammond 1919）。当然，这也意味着，他们在决定薪酬方面的发言权较小。

Thompson (1966, p. 306) put it this way: † 汤普森 (1966, 第306页) 这样说:

Weaving had offered an employment to the whole family, even when spinning was withdrawn from the home. The young children winding bobbins, older children watching for faults, picking over the cloth, or helping to throw the shuttle in the broad-loom; adolescents working a second or third loom; the wife taking a turn at weaving in and among her domestic employments. The family was together, and however poor meals were, at least they could sit down at chosen times. A whole pattern of family and community life had grown up around the loom-shops; work did not prevent conversation or singing. † 织布为全家提供了一份工作，即使纺纱已经从家里撤出。年幼的孩子绕线轴，较大的孩子观察错误，捡起布料，或帮助把梭子扔进宽幅织布机；在第二台或第三台织布机上工作的青少年；妻子轮流从事家务劳动。一家人在一起，无论饭菜多么糟糕，至少他们可以在选定的时间坐下来。织布厂周围，已经形成了一种完整的家庭和社区生活模式；工作并没有妨碍谈话或唱歌。

In Thompson's view, the power-loom sheds "were resisted until poverty broke down all defences" (p. 307), because working in a factory meant giving up most vestiges of independence and freedom.⁴² Thompson also noted that "[t]here had been a time when factories had been thought of as kinds of workhouses for pauper children; and even when this prejudice passed, to enter the mill was to fall in status from a self-motivated man, however poor, to a servant or a 'hand'" (p. 306). † 在 Thompson 看来，动力织布棚“一直被抵制，直到贫困摧毁了所有防御”（第307页），因为在工厂工作，意味着放弃大部分的独立和自由。Thompson 还指出，“曾经有一段时间，工厂被认为，是贫困儿童的济贫院；即使这种偏见过去了，进入工厂也意味着从一个自我激励的人，无论多么贫穷，变成了一个仆人或‘手’”（第306页）。

In *Industry and Empire*, Hobsbawm (1999, p. 65) agrees with this perspective, writing that "the city destroyed society." Industrial life not only forced workers to trade workplace autonomy for the regularity of factories but also forced them into unsafe factories and unsanitary housing. Cities across Britain swelled, with Manchester quadrupling in population between 1801 and 1851 (Douglas et al. 2002). Without amenities such as adequate sewers and clean water, new residents faced epidemics (including cholera and typhoid), endemic tuberculosis, and further health damage from pollution.⁴³ Hobsbawm concludes that the social change accompanying industrialization was so intolerable to preindustrial workers that tens of thousands accepted starvation wages in handloom weaving despite

⁴²These rapid changes had differential consequences for women and children in comparison to men, impacting labor force composition and family dynamics. Lyons (1989) details how families responded to deteriorating wages in the weaving industry and how women and children comprised the majority of the early factory labor force. Humphries (2013) documents the upsurge in child labor among children born between 1791 and 1850, especially in factory and mining work. Griffin (2018) discusses how even rising male wages did not necessarily translate to greater family well-being until cultural and social norms of breadwinning became more common. She stresses that hunger was common in rural and industrializing districts alike. † 与男性相比，这些快速变化，对妇女和儿童产生了不同的影响，影响了劳动力构成和家庭动态。Lyons (1989) 详细介绍了家庭如何应对纺织业日益恶化的工资，以及妇女和儿童，如何构成早期工厂劳动力的大部分。Humphries (2013) 记录了1791年至1850年间出生的儿童中，童工的激增，特别是在工厂和采矿工作中。Griffin (2018) 讨论了在养家糊口的文化和社会规范变得更加普遍之前，即使男性的工资上涨也不一定能转化为更大的家庭福祉。她强调，饥饿在农村和工业化地区都很常见。

⁴³For detailed discussion of living conditions in early English industrial cities, readers are referred to Engels (1845). † 关于早期英国工业城市生活条件的详细讨论，读者可以参考恩格斯 (1845)。

relatively higher **wages** in factories (see Figures 1 and 4). The quality of life for these workers almost certainly deteriorated with the arrival of factory-based power looms. **Handloom** weavers were among the first victims of modern creative destruction; their social and economic way of life was effectively destroyed in a few short decades (Mokyr 2020). † 在《工业与帝国》一书中，Hobsbawm（1999年，第65页）同意这一观点，他写道：“城市摧毁了社会。”工业生活，不仅迫使工人以工作场所的自主权，换取工厂的正常运转，还迫使他们进入不安全的工厂和不卫生的住房。英国各地的城市都在膨胀，1801年至1851年间，曼彻斯特的人口翻了两番（Douglas 等人，2002）。如果没有足够的下水道和清洁的水等设施，新居民将面临流行病（包括霍乱和伤寒）、地方性结核病、以及污染对健康的进一步损害。Hobsbawm 得出结论，工业化带来的社会变革，对工业化前的工人来说，是如此难以忍受，以至于尽管工厂的工资相对较高，但仍有数万人接受了饥饿的织布（见图 1 和 图 4）。随着工厂动力织机的到来，这些工人的生活质量，几乎肯定会恶化。纺织工人，是现代创造性破坏的首批受害者之一；他们的社会和经济生活方式，在短短几十年内被有效地摧毁了（Mokyr 2020）。

§6 THE RELEVANCE OF RICARDO AND THOMPSON TODAY † RICARDO 和 THOMPSON 当代相关性

The lessons that David Ricardo and E.P. Thompson learned remain important today, for we are in the midst of a potentially rapid transformation of work due to digital technologies and AI. † David Ricardo 和 E.P. Thompson 学到的经验教训，在今天仍然很重要，因为我们正处于数字技术和人工智能，带来的工作潜在地快速转型之中。

§6.1 Labor Demand and Working Conditions in the Age of Artificial Intelligence † 人工智能时代的劳动力需求和工作条件

One perspective is that automation, because it increases average **productivity** by substituting cheaper and more reliable machines and algorithms for human labor, will ultimately be good for workers. According to this view, the economy may need fewer blue-collar and office workers as these tasks are automated, but as firms and consumers are enriched by the rising **productivity**, there will be demand for workers in other sectors (e.g., Aghion et al. 2019). However, Ricardo’s concerns remain relevant today. We now also have evidence that automation significantly reduces the share of labor in national income and can depress labor demand, employment, and **wages** (e.g., Acemoglu & Restrepo 2020, 2022). The debate is not settled, but there is growing evidence that during the period of rapid automation, essentially since 1980, **wages** have not risen much, and a significant fraction of the US labor force has experienced declining real **wages** (e.g., Acemoglu & Autor 2011; Acemoglu & Restrepo 2020, 2022). † 一种观点认为，自动化最终将对工人有利，因为它通过用更便宜、更可靠的机器和算法代替人力，来提高平均**生产率**。根据这一观点，经济可能需要更少的蓝领和办公室工作人员，因为这些任务是自动化的，但随着企业和消费者因生产力的提高而富裕起来，其他行业也会对工人产生需求（例如，Aghion等人，2019）。然而，Ricardo的担忧，在今天仍然具有现实意义。我们现在也有证据表明，自动化，显著降低了劳动力在国民收入中的份额，并可能抑制劳动力需求、就业和工资（例如，Acemoglu & Restrepo 2020, 2022）。争论尚未解决，但越来越多的证据表明，在快速自动化时期，基本上自1980年以来，**工资**没有大幅上涨，美国很大一部分劳动力的实际工资，正在下降（例

如, Acemoglu & Autor 2011; Acemoglu & Arestrepo 2020, 2022)。

It remains to be seen how AI will alter this picture, exacerbating some of the existing trends but also potentially creating new opportunities for workers. Despite the powerful and diverse capabilities of new AI tools, there is already some evidence that this suite of technologies has primarily been used for more automation (Acemoglu et al. 2022). Thompson's perspective is also highly relevant to current debates. † 人工智能, 将如何改变这一局面, 加剧一些现有的趋势, 但也可能为工人创造新的机会, 还有待观察。尽管新的人工智能工具, 具有强大而多样的功能, 但已经有一些证据表明, 这套技术, 主要用于更多的自动化 (Acemoglu 等人, 2022)。Thompson 的观点, 也与当前的辩论高度相关。

In *In the Age of the Smart Machine*, Zuboff (1988) pointed out that the advance of digital technology potentially has a dark side for workers. Lowering the cost of monitoring has encouraged employers to become more intrusive and allowed them to watch their employees more closely. Rapid recent increases in the capabilities of AI have the potential to push further in this same direction. † Zuboff (1988) 在《智能机器时代》一书中指出, 数字技术的进步, 可能对工人有不利的一面。降低监控成本, 鼓励雇主变得更具侵入性, 并允许他们更密切地观察员工。最近人工智能能力的快速增长, 有可能进一步朝着这个方向发展。

The modern version of Thompson's dystopia would include control over the workday and what happens in the workplace, minute by minute, for all kinds of workers. Some of this might be used to improve workplace safety and protect employees (e.g., against harassment), but there is already evidence that technology is being used to drive workers harder and even encourage them to cut corners and work in less safe conditions (Acemoglu & Johnson 2023). † 汤普森反乌托邦的现代版本, 将包括对工作日的控制, 以及对各种工人每分钟在工作场所发生的事情的控制。其中一些, 可能用于提高工作场所的安全性和保护员工 (例如, 防止骚扰), 但已经有证据表明, 技术, 正被用来让工人更加努力, 甚至鼓励他们偷工减料, 在不太安全的条件下工作 (Acemoglu & Johnson 2023)。

Overall, should we expect that **productivity** gains from AI will be shared with workers? Ricardo's insights suggest there is no guarantee that they will be if automation is the only focus of new AI technologies. If AI is used to create new tasks and increase human capabilities, the benefits would be more likely shared with labor. Thompson's insights add another major caveat: If AI is used extensively for surveillance and worker control, it will shift the balance of power between workers and managers, making it less likely that labor will capture much of the **productivity** gains. † 总体而言, 我们是否应该期望, 人工智能带来的**生产力**收益将与工人分享? Ricardo 的见解表明, 如果自动化是新人工智能技术的唯一重点, 那么就不能保证会是这样。如果人工智能, 被用来创造新的任务并提高人类的能力, 那么这些好处更有可能与劳动力分享。Thompson 的见解, 增加了另一个主要警告: 如果人工智能, 被广泛用于监控和工人控制, 它将改变工人和管理者之间的权力平衡, 使劳动力不太可能获得大部分**生产率**提高的收益。

§6.2 The Direction of Technological Change † 技术变革的方向

Combining Ricardo's revised thinking about machines and Thompson's ideas about the balance of power in factories provides an enriched account of the effects of the early Industrial Revolution on

labor.⁴⁴ However, missing from both of their accounts is another important element: the centrality of technological choices. † 结合 Ricardo 关于机器的修正思想和 Thompson 关于工厂的权力平衡的思想, 为早期工业革命对劳动力的影响, 提供了丰富的解释。然而, 他们两人的叙述中, 都缺少了另一个重要因素: 技术选择的中心地位。

It was not preordained by advances in technology, engineering, or business organization that improved machinery would reduce the demand for labor in the early decades of the nineteenth century, or that the factory system would disempower workers and push them into much harsher working conditions. These were choices. The direction of technology is highly malleable and responds to economic incentives as well as the political and bargaining power of different parties affected by the technology (Acemoglu 2001, 2002; Acemoglu & Restrepo 2018; Acemoglu & Johnson 2023). The same is doubly true for organizational choices — after all, modern factories could be set up without such long hours or such harsh conditions for working people. † 技术、工程或商业组织的进步, 并没有预先注定, 在19世纪初, 改进的机械会减少对劳动力的需求, 或者工厂制度会剥夺工人的权力, 迫使他们变得更加严厉的工作条件。这些都是选择。技术的方向, 具有高度的可塑性, 并对经济激励、以及受技术影响的不同政党的政治、和议价能力做出反应 (Acemoglu 2001, 2002; Acemoglu & Restrepo 2018; Acemoglu & Johnson 2023)。对于组织选择来说, 情况也是如此 — 毕竟, 现代工厂, 可以在没有如此长的工作时间或如此恶劣的劳动条件下建立。

Recognizing the essential role of choice over the direction of technology and organizational forms is not only relevant for understanding the early decades of the Industrial Revolution; it is also critical to appreciate how and why things started changing from around 1850 onward. As we have explained elsewhere (Acemoglu & Johnson 2023), these changes were the result of innovations that prioritized increasing the marginal **productivity** of labor, most importantly by introducing new tasks for workers. For example, new technologies in railways and heavy industry introduced novel activities and capabilities for workers. American technologies that emphasized boosting the **productivity** of unskilled labor by standardizing parts and processes introduced new technical tasks for laborers and spread throughout Europe, including the United Kingdom. † 认识到选择对技术和组织形式方向的重要作用, 不仅与理解工业革命的早期几十年有关; 了解事情从1850年左右开始是如何、以及为什么开始变化的, 这一点也很重要。正如我们在其他地方解释的那样 (Acemoglu & Johnson 2023), 这些变化是创新的结果, 这些创新, 优先考虑提高劳动力的**边际生产率**, 最重要的是为工人引入新任务。例如, 铁路和重工业的新技术, 为工人带来了新的活动和能力。美国技术强调通过标准化零件和工艺, 来提高非熟练劳动力的生产力, 为劳动者引入了新的技术任务, 并传播到包括英国在内的整个欧洲。

Modern manufacturing started employing more workers including in design, repair, maintenance, and clerical tasks. These technological trends laid the foundation for more shared prosperity, where wage growth went hand in hand with higher profits for businesses. Critically, this type of sharing was also undergirded by a changing balance between capital and labor, as voting rights expanded and trade

⁴⁴For literature on the endogenous direction of technological change, readers are referred to Acemoglu (1998, 2002) as well as Acemoglu & Restrepo (2018) in the context of automation versus new tasks. For the endogenous evolution of institutions impacting how gains from new technologies are shared, readers may consult Acemoglu & Johnson (2023, chapters 1, 8). † 关于技术变革内生方向的文献, 读者可以参考 Acemoglu (1998, 2002) 以及 Acemoglu & Restrepo (2018) 在自动化与新任务的背景下的研究。关于影响新技术收益分享方式的制度内生演变, 读者可以参考 Acemoglu & Johnson (2023, 第1章, 第8章)。

unions were empowered to negotiate **wages** and working conditions. Factories were now everywhere, but they no longer subjected workers to the same horrendous conditions for longer hours, nor could they employ and exploit very young children. The importance of choice in the direction of technology may be even more central today, to understand how AI could affect labor markets, than it was in the Industrial Revolution. One promise of AI is its capability to provide much better information to humans for problem-solving tasks and decision-making. If such a path for AI was feasible (which we believe it is, as we argue in Acemoglu et al. 2023; see also Acemoglu 2023) and if it was prioritized, we could move to a different phase of modern economic growth than the nonshared variant ushered in by the digital and robotic technologies of the last four decades. † 现代制造业开始雇佣更多的工人，包括设计、维修、维护和文书工作。这些技术趋势，为更共享的繁荣奠定了基础，工资增长，与企业更高的利润齐头并进。至关重要的是，随着投票权的扩大、工会被授权就工资、和工作条件进行谈判，资本和劳动力之间不断变化的平衡，也加强了这种共享。工厂现在到处都是，但它们不再让工人长时间处于同样可怕的条件，也不能雇用和剥削年幼的儿童。如今，在理解人工智能如何影响劳动力市场方面，选择在技术方向上的重要性，可能比工业革命时更为重要。人工智能的一个前景，是它能够为人类提供更好的信息，用于解决问题和决策。如果人工智能的这条道路是可行的（正如我们在 Acemoglu 等人2023中所说的那样；另见 Acemoglu 2023），如果它被优先考虑，我们可以进入一个阶段，一个与过去四十年数字和机器人技术带来的非共享变体不同的现代经济增长阶段。

Critically, this is a choice. The evidence we have briefly discussed suggests we may be heading down a different path, with much less favorable implications for labor. If AI amplifies automation and surveillance, its impact on labor could be as bad as, or even worse than, what Ricardo and Thompson were concerned about in the early stages of the Industrial Revolution. † 至关重要的是，这是一种选择。我们简要讨论的证据表明，我们可能正在走一条不同的道路，对劳动力的影响，要小得多。如果人工智能，扩大了自动化和监控，它对劳动力的影响，可能会像 Ricardo 和 Thompson 在工业革命早期所担心的那样糟糕，甚至更糟。

§7 CONCLUSION † 结论

Despite rapid improvements in the **productivity** of cotton manufacturing, the early decades of the nineteenth century were not buoyant times for British workers. Skilled artisans, especially **handloom** cotton weavers, lost their relatively high pay and autonomy, while average real **wages** for all workers were stagnant or declining, even as **productivity** in the economy rose. It was presumably these developments that made David Ricardo, a founder of modern economics, change his mind about the question of machinery. While Ricardo had previously assumed that new machinery that raised average **productivity** would also mean greater demand for labor, more employment, and higher **wages**, he had good reason to revise his thinking on this critical question in the early 1820s. We have much to learn from Ricardo's openness to new ideas and new ways of thinking about economics as he observed very different effects of machinery on labor than he had previously presumed. † 尽管棉花制造业的生产率迅速提高，但19世纪初对英国工人来说，并不是一个繁荣的时期。熟练的工匠，尤其是手织棉纺工，失去了相对较高的工资和自主权，而所有工人的平均实际工资停滞不前或下降，尽管经济生产力有所提高。也许正是这些发展，使现代经济学的创始人 David Ricardo 改变了对机械问题的看法。虽然 Ricardo 之前认为，提高平均生产率的新机器也意味着对劳动力的更大需求、更多的就业机会和更高

的工资，但他有充分的理由，在19世纪20年代初修改他对这一关键问题的看法。我们可以从 Ricardo 对经济学新思想和新思维方式的开放态度中，学到很多东西，因为他观察到，机器对劳动的影响与他之前的假设截然不同。

Going one step further, we suggest that Ricardo's productive thinking on this question may need to be combined with ideas about how new technologies and organizational forms fundamentally change the balance of power between capital and labor, as argued, for example, by the historian E.P. Thompson. Thompson's work, drawing on a large body of original sources and research by other historians, demonstrates that the new factory system also subjected workers to greater discipline, more intense monitoring, and a regimen with much less autonomy and arguably less specialized, skilled work. † 更进一步，我们认为 Ricardo 在这个问题上的富有成效的思考，可能需要与新技术和组织形式如何从根本上改变资本和劳动力之间的权力平衡的想法相结合，例如历史学家 E.P. Thompson 所说的那样。Thompson 的工作，借鉴了大量原始资料和其他历史学家的研究，表明新的工厂制度，也使工人受到更严格的纪律、更严格的监督，以及一种自治程度低得多、专业性低、技术含量低的格式。

Learning from Ricardo and Thompson is particularly important today because we are in a similarly transformative and disruptive process of technological change. The machinery in question is no longer the factory system and textile equipment, but rather advanced digital machinery and algorithms. On the horizon, we have AI potentially accelerating these technological trends and disruptions. † 今天，向 Ricardo 和 Thompson 学习，尤为重要，因为我们正处于一个类似的变革和颠覆性的技术变革过程中。所讨论的机器，不再是工厂系统和纺织设备，而是先进的数字机器和算法。在地平线上，人工智能有可能加速这些技术趋势和颠覆。

Expecting that new digital tools would not only boost **productivity** but also raise employment and **wages** has been a natural conjecture for many economists and policymakers. However, we now know that the impact of digital technology has been more complex and less positive for many working people in the industrialized world. Since 1980, inequality has increased at a staggering rate in the United States, and less educated workers have experienced significant declines in their real **wages** (Acemoglu & Autor 2011, Autor 2019). Although the precise experiences of other countries vary, the general pattern of increasing inequality since the 1980s has been the norm (OECD 2015). Recent evidence also shows that new digital technologies, including robotics, automated equipment, and office automation, have led to declines in the real earnings and employment of workers who used to specialize in tasks that are now being performed by machinery and algorithms (Acemoglu & Restrepo 2020, 2022). In the meantime, AI and other new tools are also intensifying surveillance and shifting the balance of power from labor to capital (Acemoglu & Johnson 2023). † 对于许多经济学家和政策制定者来说，期望新的数字工具，不仅能提高生产率，还能增加就业和工资，这是一个自然的猜测。然而，我们现在知道，数字技术的影响，对工业化世界的许多劳动人民来说，更加复杂，也不那么积极。自1980年以来，美国的不平等现象，以惊人的速度加剧，受教育程度较低的工人的实际工资，大幅下降 (Acemoglu & Autor 2011, Autor 2019)。尽管其他国家的确切经验各不相同，但自20世纪80年代以来，不平等加剧的总体模式，一直是常态 (OECD经合组织，2015年)。最近的证据还表明，包括机器人、自动化设备和办公自动化在内的新数字技术，导致了过去专门从事现在由机器和算法执行的任务的工人的实际收入和就业率下降 (Acemoglu & Restrepo 2020, 2022)。与此同时，人工智能和其他新工具，也在加强监控，并将权力平衡从劳动力转移到资本 (Acemoglu & Johnson 2023)。

Following Ricardo, this may be a time for us to rethink how machinery (and algorithms) impacts labor and how we can make choices about the direction of technology and policy to ensure that workers with diverse skills also benefit from new technologies. † 跟随 Ricardo, 这可能是我们重新思考机器 (和算法) 如何影响劳动力的时候了, 以及我们如何对技术和政策的方向做出选择, 以确保具有不同技能的工人, 也能从新技术中受益。

DISCLOSURE STATEMENT

The authors are not aware of any affiliations, memberships, funding, or financial holdings that might be perceived as affecting the objectivity of this review. † 作者不知道, 任何可能影响本综述客观性的隶属关系、会员资格、资金或财务持有情况。

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表 1 Nominal earnings and expenses of handloom weavers in Lancashire, 1814 - 1833 †
 1814-1833年 Lancashire 手织布工的名义收入和支出

Table 1 Nominal earnings and expenses of handloom weavers in Lancashire, 1814-1833*

Year	Near Colne				Near Oldham		
	(1) A family could earn ^b (shillings)	(2) Repair of looms, rent, etc. (shillings)	(3) Leaving for other costs ^c (shillings)	(4) Yearly income (£)	(5) Wage (shillings)	(6) 63-hour wage (shillings)	(7) Expenses ^d (shillings)
1814	52.00	5.25	46.75	135.20	2.29	13.75	3.63
1815	34.17	5.25	28.92	88.83	1.96	11.75	3.27
1816	26.83	5.25	21.58	69.77	1.50	9.00	2.79
1817	24.17	5.25	18.92	62.83	1.08	6.50	2.35
1818	28.83	5.25	23.58	74.97	1.46	8.75	2.71
1819	25.00	5.25	19.75	65.00	1.67	10.00	2.92
1820	23.33	5.25	18.08	60.67	1.50	9.00	2.73
1821	28.31	5.25	23.06	73.61	1.42	8.50	2.63
1822	22.88	5.25	17.63	59.48	1.50	9.00	2.69
1823	21.00	5.25	15.75	54.60	1.58	9.50	2.75
1824	19.13	5.25	13.88	49.73	1.58	9.50	2.73
1825	19.13	5.25	13.88	49.73	1.46	8.75	2.58
1826	11.83	4.25	7.58	30.71	1.08	6.50	2.13
1827	14.63	4.25	10.38	38.03	1.08	6.50	2.19
1828	14.63	4.25	10.38	38.03	1.17	7.00	2.25
1829	10.50	4.25	6.25	27.03	1.00	6.00	2.06
1830	13.50	4.25	9.25	35.11	0.83	5.00	1.88
1831	14.83	4.25	10.58	35.11	0.83	5.00	1.88
1832	12.00	4.25	7.75	30.71	0.79	4.50	1.77
1833	12.00	4.25	7.75	31.20	0.79	4.50	1.75

*Table adapted from Wood (1910d, table 34).

^aEarnings and expenses represent weekly values unless otherwise indicated. All columns have been converted into a single denomination from the original table. Conversion factors used were 1£ = 20s = 240d.

^bThis is for a family of 6 persons including 3 children.

^cOther costs are food, clothing, etc.

^dExpenses are rent, fuel, etc.

表 2 Employment in the British cotton industry, 1788 - 1862 † 1788-1862年英国棉花业的就业情况

Table 2 Employment in the British cotton industry, 1788-1862

Year	Factory employment (thousands)			Handloom weavers (thousands)
	Spinning	Weaving	Total	
1788	60	ND	60	108
1801	83	ND	83	164
1806	90	Few	90	184
1813	104	3	107	212
1817	111	10	121	228
1820	115	11	126	240
1823	120	15	135	240
1824	122	45	167	240
1825	124	49	173	240
1831	131	56	187	240
1832	132	64	196	227
1833	133	75	208	213
1835	ND	ND	220	188
1839	ND	ND	259	135
1847	ND	ND	277	53
1850	ND	ND	331	40
1856	ND	ND	379	23
1862	ND	ND	452	3

Abbreviation: ND, no data. Table adapted from Wood (1910e, table 40).

表 3 Nominal daily earnings of coal workers, 1800 - 1835 † 1800-1835年煤炭工人的名义日收入

Table 3 Nominal daily earnings of coal workers, 1800-1835^a

Year	Northumberland (shillings)	Durham (shillings)	Yorkshire (shillings)		Lancashire and Cheshire (shillings)	East Midlands (shillings)	Staffordshire (shillings)		South Wales (shillings)	Scotland (shillings)
			South	West			North	South		
1800-1802	2.75	2.75	2.93	2.80	4.27	2.67	2.51	ND	3.10	2.99
1804-1806	ND	ND	ND	ND	ND	3.52	2.76	ND	ND	3.49
1811	ND	ND	ND	ND	ND	ND	ND	ND	5.02	ND
1813-1814	3.37	3.31	3.09	2.95	4.48	3.52	ND	ND	3.34	3.32
1818	2.70	2.80	ND	ND	ND	ND	ND	ND	ND	ND
1819	2.49	2.52	2.61	2.50	4.00	ND	ND	ND	2.90	3.24
1822	2.70	2.80	2.88	2.75	4.27	2.99	ND	ND	3.00	3.75
1825	3.89	3.78	3.41	3.30	4.59	3.41	ND	ND	4.23	5.01
1826	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.50
1827	2.70	2.80	ND	ND	ND	ND	ND	ND	4.23	4.00
1828	2.70	2.80	ND	ND	ND	ND	ND	ND	ND	4.00
1829	2.49	2.52	2.93	2.80	4.27	2.88	3.00	4.00	3.74	4.00
1830	2.70	2.80	2.93	2.80	4.27	2.93	3.19	4.00	3.93	4.00
1831	3.79	3.73	2.93	2.80	4.27	2.93	3.38	4.00	4.23	4.00
1832	3.48	3.50	2.93	2.80	4.27	2.93	3.38	4.00	3.98	4.00
1833	3.37	3.13	2.93	2.80	4.53	2.93	3.38	4.00	3.93	4.00
1834	3.37	3.13	3.20	3.05	4.80	3.20	4.01	4.00	3.98	4.00
1835	3.37	3.13	3.47	3.35	4.80	3.52	4.16	4.00	4.23	4.00

Abbreviation: ND, no data. Table adapted from Mitchell (1984, table 7.1).

^aThe table represents shift earnings of coal hewers. Index values have been converted to currency using values found in Mitchell (1984, table 7.1, note ii). All columns have been converted to a single denomination using the following conversion factors: 1£ = 20s = 240d.

表 4 Builders' and agricultural workers' wages, 1710 - 1859 † 1710-1859年建筑工人和农业工人的工资

Table 4 Builders' and agricultural workers' wages, 1710-1859

Decade	Builders ^a			Agricultural workers ^b	
	Craftsman's day wage (pence)	Helper's day wage (pence)	Relative wage	Raw average day wage (pence)	Estimated average day wage (pence)
1710-1719	19.7	12.1	1.63	10.5	9.9
1720-1729	20.0	12.4	1.62	10.1	9.6
1730-1739	20.3	12.6	1.62	10.2	10.8
1740-1749	20.6	12.6	1.63	11.1	10.8
1750-1759	20.5	13.1	1.57	12.2	10.9
1760-1769	21.3	13.9	1.53	11.2	11.7
1770-1779	22.3	15.1	1.48	11.4	12.5
1780-1789	23.4	15.3	1.53	11.8	13.2
1790-1799	26.8	17.9	1.50	14.5	15.6
1800-1809	35.9	23.9	1.51	19.1	19.0
1810-1819	43.8	29.8	1.47	23.2	23.0
1820-1829	42.1	27.0	1.56	22.2	20.6
1830-1839	42.7	28.0	1.53	21.3	20.3
1840-1849	43.3	29.0	1.50	22.5	21.2
1850-1859	45.6	30.1	1.52	22.4	21.9

^aColumns regarding builders are from Clark (2005, table A2).

^bColumns regarding agricultural workers are from Clark (2007, table 1).

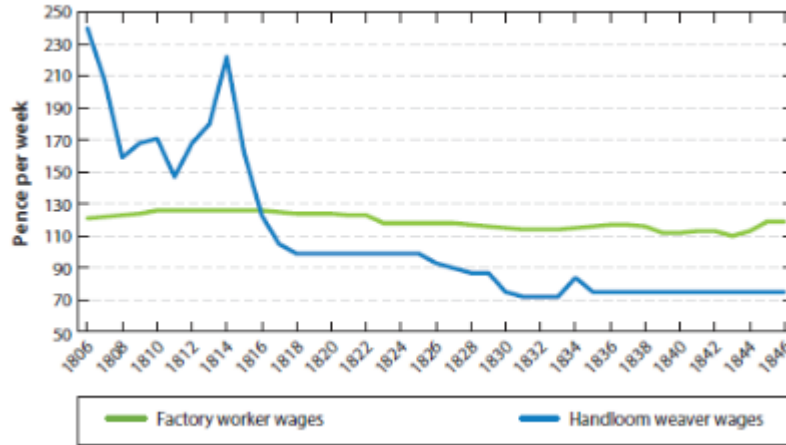


图 1 Handloom weaver and factory worker nominal wages. Nominal wages are from Wood (1910e). Factory workers include spinners and weavers. † 手织工和工厂工人的名义工资。名义工资来自 Wood (1910e)。工厂工人，包括纺纱工和织布工。

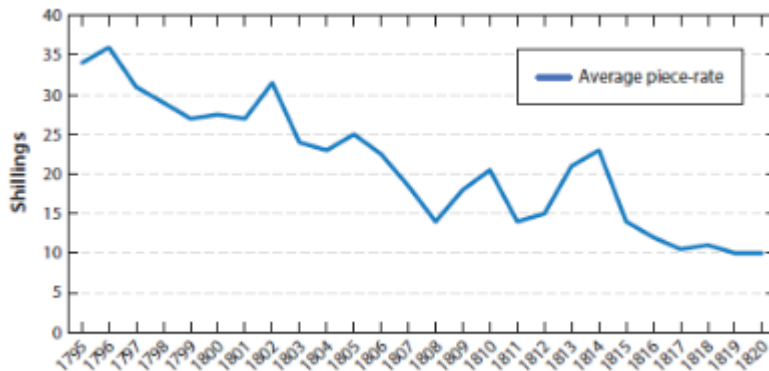


图 2 Piece-rate for muslin weaving at Bolton, 1795 - 1820. Price reflects the rate for 60-reed cambric muslin. Data are from Bythell (1969, table 2). † 1795年至1820年 Bolton 的细棉布织造计件率。价格反映了60根芦苇细棉布的价格。数据来自 Bythell (1969, 表2)

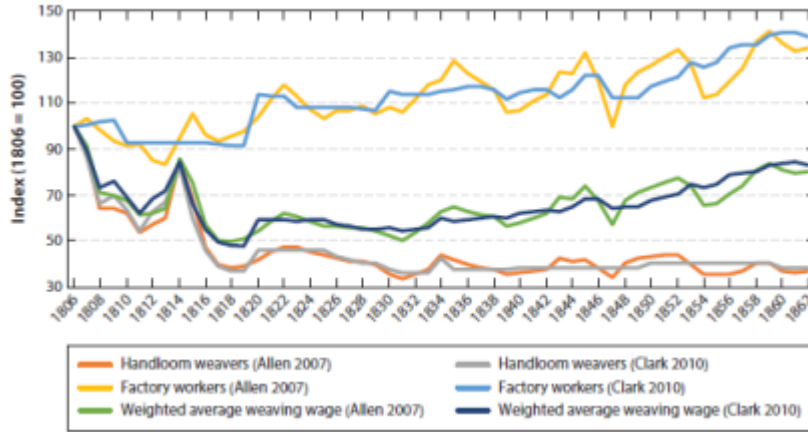


图3 1806-1862年纺织工人的实际每周工资，按生活成本指数（1806 = 100）划分，根据 Allen（2007）和 Clark（2010）的生活成本指数。纺织工人的工资，来源于 Wood（1910e，表41）。加权平均值是手织工和工厂工人工资的平均值，按就业情况加权。
 † 根据 Allen（2007）和 Clark（2010）的生活成本指数，1806-1862年按生活成本指数（1806 = 100）划分的纺织工人的实际每周工资。纺织工人的工资，来源于 Wood（1910e，表41）。加权平均值是手织工和工厂工人工资的平均值，按就业情况加权。

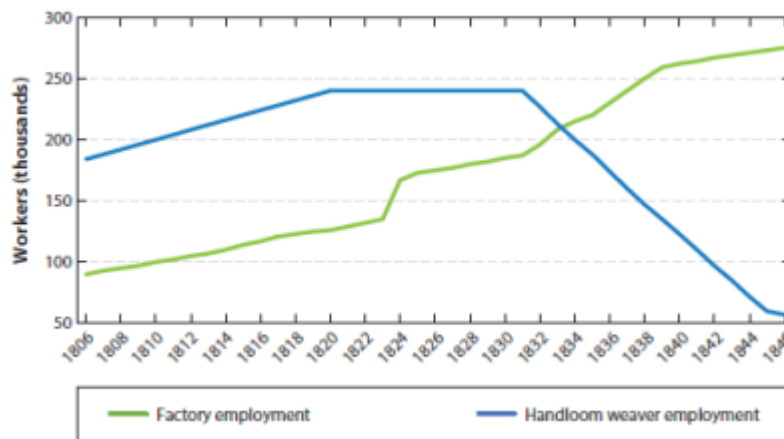


图4 手织工和工厂工人就业。就业数据来自 Wood（1910e）。工厂工人，包括纺纱工和织布工。
 † 手织工和工厂工人就业。就业数据来自 Wood（1910e）。工厂工人，包括纺纱工和织布工。

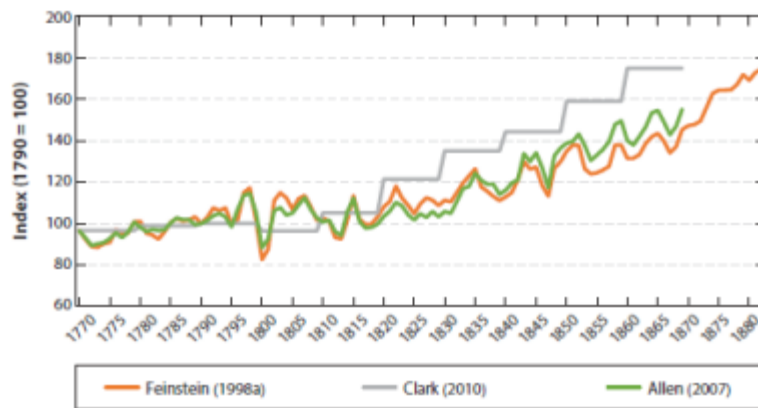


图 5 Economy-wide real wages (1790 = 100), 1770 – 1882. The figure shows economy-wide wages weighted by occupation and population. Feinstein (1998a) bases his nominal wage series largely on the work of Bowley (1898) and Wood (1910a – e). Allen uses Feinstein’s nominal wages. Clark constructs his own series from Clark (2001, 2005, 2007), drawing on archival sources including Bowley and Wood. Figure adapted with permission from Allen (2007). † 1770-1882年，整个经济体的实际工资（1790，=100）。该图显示了按职业和人口加权的整个经济工资。Feinstein（1998a）的名义工资系列主要基于 Bowley（1898）和 Wood（1910a - e）的工作。Allen 使用Feinstein 的名义工资。Clark 从 Clark（2001、2005、2007）那里构建了自己的系列，借鉴了包括 Bowley 和 Wood 在内的档案资料。图改编自 Allen（2007）的许可。

Resume of the authors † 作者简介



Daren Acemoglu, 1967年出生于土耳其伊斯坦布尔, 1992年获英国伦敦政治经济学院博士学位, 目前是美国麻省理工学院教授。他研究领域包括宏观经济学、政治经济学、劳动经济学、发展经济学等。与 Simon Johnson 曾共同撰写著作: 《权力与进步: 我们为技术与繁荣而进行的千年斗争》。Daron Acemoglu 与 Simon Johnson和芝加哥大学的 James A. Robinson 共享 2024 年诺贝尔经济学奖。



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