on the Utility of Employing Machines to Shorten Labour, 1780.²

At a more theoretical level, Adam Smith and Lord Lauderdale discussed central issues in the development of technology and its relationship to the dynamic transformation of the economy. Smith’s theory of the division of labour was basic to his analysis of rising labour productivity, and formed the cornerstone of his theory of economic growth. Lauderdale was more interested in capital formation, and came by this route to examine the economic impact of the machine.

Smith connected the division of labour with several factors contributing to greater productivity of labour. These factors were greater dexterity, economy of time, and the introduction of machinery. Perhaps the most far-reaching step Smith took in establishing these connections was to show that the division of labour was self-reinforcing. It gave rise to vital dynamic links between an expanding market, the regeneration of skills and the emergence of a class of machine makers.³ The definition of such connections between the market and the differentiation of technique brought with it a change in the meaning of the word skill. Skill, once identified with an ‘art’ or craft, became in Smith’s hands a ‘peculiar dexterity’ which resulted from the breakdown of a craft.⁴ The division of labour now became the material basis for a separation between mental and manual labour. The leisure it allowed the members of some classes gave them the time and cultural scope necessary to scientific discovery. This division between the labourer and the natural philosopher justified further social hierarchies, and Smith was, therefore, able to account for the separation between the machine maker and the machine minder.⁵

Smith established the equally important dynamic interaction of the accumulation of capital and technical progress: ‘As the division of labour advances, therefore, in order to give constant employment to an equal number of workmen, an equal stock of provisions, and a greater stock of materials and tools than what would have been necessary in a ruder state of things, must be accumulated beforehand.’⁶ The connection Smith established between capital accumulation and technical change allowed him to ignore labour displacement: ‘But the

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¹ Thomas Barnes was a Unitarian preacher and lecturer at the Warrington Academy where some of the first Lancashire cotton manufacturers were educated. He was also one of the founders of the Manchester Literary and Philosophical Society.

² This pamphlet is noted by Lord Lauderdale in his An Inquiry into the Nature and Origin of Public Wealth, Edinburgh, 1804, p. 298.


⁴ Ibid. pp. 17–18, 139–40.

⁵ Ibid. pp. 20–1.

⁶ Ibid. p. 277.
number of workmen in every branch of business generally increases with the division of labour in that branch; or rather it is the increase of their number which enables them to class and subdivide themselves in this manner. Machinery did not displace labour. Rather, it differentiated this labour by dismembering the old craft.

Lauderdale presented the process of technical change somewhat differently. Where Smith envisaged the expansion of employment in the process of capital formation and the division of labour, Lauderdale argued that the introduction of machinery was purely a labour-saving device. He referred to the stocking knitters and the new machine looms: "The profit of stock employed in machinery is paid out of a fund that would otherwise be destined to pay the wages of the labour it supplants." Furthermore, Lauderdale related the impact of labour-saving machinery to the social conflict of his own time: 'It derives ample testimony of its truth from the conduct of the unlettered manufacturers themselves, as is sufficiently evinced by the riots that have taken place on the introduction of various pieces of machinery, and particularly at the time when the ingenious machines for carding and spinning were first set a-going." Smith did not refer to such social conflict, but he did show concern for the mental and cultural degeneration produced among the lower classes by the division of labour.

Moreover, both Smith and Lauderdale were worried about the connections between this degeneration and the inventive capacity of a nation. Both argued that the division of labour could have a stultifying effect on ingenuity. Smith identified barbarous societies with varied occupation: 'Invention is kept alive, and the mind is not suffered to fall into that drowsy stupidity, which, in civilized society, seems to benumb the understanding of almost all the inferior ranks of people." Lauderdale, too, believed that there was a logical gap between the division of labour and the type of conceptualisation necessary to the invention of machinery. The principle behind the invention of machinery was to combine and embrace within one machine the execution of the greatest possible variety of operations in the formation of a commodity. But the division of labour was destructive of the chain of reasoning necessary to the perfection of machinery.

Smith and Lauderdale thus demonstrated an awareness of the social

and economic dimensions of the new techniques of production. But, although we find in their writing both an impressive depth of analysis of technology and an ambivalence towards this technology which provided many nineteenth-century economic writers with their starting-points, the context was not one to make the machinery question a vital issue. In the first place the economic context was different. In part, the significance of the machinery question was defined by the economic and technological transformation which is described in the last chapter. The early nineteenth-century British economy was one where mechanisation was strikingly evident, but where large sectors of the economy still remained untouched by it. This technological setting was complemented by an economy recovering from war. Crisis, depression, and unemployment appeared to contemporaries to owe their causes as much to the new technology as to post-war economic adjustment. A second and equally important context for the emergence of the machinery question as a national issue was an intellectual one. Machinery became an issue at virtually the same time as the formation of a new intellectual discipline: political economy. It was no mere coincidence that political economy established itself as an academic discipline and popular doctrine at the same time as the industrial revolution in cotton and iron.

For it was only from the 1790s that political economy broke free from the place allotted to it by previous writers, including Adam Smith, as a branch of legislation or statesmanship. The theories and opinions to be found in earlier economic writings were not systematically set out, as were those in nineteenth-century political economy, as an accepted set of concepts and problems whose central purpose was to analyse the present position and future prospects of the economy. Significantly, Adam Smith's first intellectual biographer and re-interpreter, Dugald Stewart, was one of those who led the way in the 1790s in assigning the theory of government and political economy to two separate branches of political science. Political economy he defined as 'that which is most immediately connected with human happiness and improvement': it could be 'studied without reference to constitutional forms - not only because the tendency of laws may be investigated abstractly from all considerations of their origin but because there are many principles of political economy which may be sanctioned by governments very different in their constitutions.'
This appointment of political economy to a separate branch of inquiry was followed some years later by J. R. McCulloch's attempt to explain its emergence on materialist grounds. The science could only arise, he argued, in a commercial capitalist society. Slave societies had no knowledge of the categories political economy dealt in, for they had no experience of relations between landlords and tenants, and between masters and servants. They could therefore take 'no interest in questions rising out of the rise and fall of rents and wages'. A further reason for the science emerging as late as it did was social climate 'prejudicial' in ancient and medieval economies to the accumulation of wealth and to commerce and manufacture. The writer who reviewed McCulloch's tract for the Edinburgh Review tied the discipline more explicitly to recent improvements in industry. He claimed that political economy was the science which could teach us how to make industry more productive, and was therefore 'the science to which we are indebted for all the higher refinements'. It was in countries 'where circumstances were favourable or where political economy was well understood' that an intelligent artisan could 'enjoy a multiplicity of comforts and luxuries' which were 'utterly unattainable in a rude state of society'.

Halévy, a subsequent observer, also made some connection between economic change and the emergence of political economy. Singling out the period between Smith and Ricardo as one in which not one single complete treatise on political economy had appeared in England, Halévy argued that, without the assistance or knowledge of the legislature, or even of the intellectuals, a new industrial world had arisen. This transformation brought with it, he argued, a whole series of problems leading on the one hand to the great series of parliamentary inquiries, and on the other, in the theoretical sphere, to the theory of rent.

Developing the implications of this remark, I would argue that Dugald Stewart's definition of the economy as an object of inquiry separate from the state or polity was in fact the first stage in the formation of the discipline of political economy as a response to the need to understand the economy. He not only defined political economy as a separate discipline; he regarded it as the most important discipline to the happiness of mankind. He argued that 'mistaken notions concerning political liberty so widely disseminated in Europe by the writings of Locke have contributed greatly to divert the studies of speculative politicians from the proper objects of their attention'. Happiness was the only object of legislation which was of intrinsic value, and 'of the two branches of political science - the theory of government and political economy - the latter is that which is most immediately connected with human happiness and improvement'. Such statements account in intellectual terms for the beginnings of a separate existence for political economy and of claims for its significance in providing fundamental directions and principles for government policy. But behind such reasons were to be found other deeper motivations, as hinted at by McCulloch, to understand the economy and a specific desire, perceived by Halévy, to understand an economy cast in the turbulence of rapid technological change.

Few historians, however, have given much attention to possible connections between the parallel development of industry and political economy, and there are clear historiographical reasons for this. Orthodox historians, fearing that they lacked expertise, have only paid lip-service to the significance of political economy, and have deferred to the judgements of economists who specialise in the history of economic thought. But these have not filled the gap, for they have their own concerns and orientations. Since the foundations of their discipline economists have been interested in the antecedents of their own theories. But the uncovering of antecedents is rarely a problem for the historian. However much we may know of the 'precursors' of a wide range of concepts and theories currently in vogue among economists, we actually know very little about the more fundamental problem of the origin of the discipline. This is because the question has just not been asked. It is, nevertheless, the most important historical question in any study of political economy or economic policy which requires an answer. In contrast with the economist, the historian wants to know what happened and why, and to explain change and development. The historian's history of economic thought should seek to explain what economists were doing in the past and the reasons for their work. Furthermore, it should seek to inscribe in the history of ideas the personal and social contexts of the theorists.


16 Dugald Stewart, Lectures on Political Economy, p. 93.

17 Ibid.
This bold demarcation between the economics of land and industry must, however, be subject to many qualifications. Among those ranked on either side of this theoretical divide there were great differences in assumptions and allegiances. Furthermore, broad political divisions between types of economic theory in ascendency were complemented by more specific divisions over policy, and these policy stands can be identified over the series of crises which punctuated the period between 1815 and the 1840s. For such crises commentators could offer a wide choice of diagnoses, between blaming trade restrictions or over-production, taxation or the paper currency, over-population or machinery. But each economic diagnosis was also a political choice, as differing schools of economic thought in these years also reflected differences in politics. G. S. L. Tucker has aptly formulated the connections of nineteenth-century theories of profit with practical questions of economic policy. The intellectual interest in explaining a secular decline in the earnings of capital was a feeble incentive beside the desire to account for the facts of contemporary experience and to give some guidance to economic policy in wartime and post-war Britain. The Corn Laws, the national debt, taxation, foreign investment and colonial development, the introduction of machinery, financial crises and trade fluctuations, were all problems requiring some analysis of the direction of profits.\footnote{19}

Thus theoretical controversy often involved political controversy, particularly between the Whigs and the Tories. The period 1815 to 1832 was dominated by the Tory ministries, all of which took on the policy prescriptions of the classical economists. As A. J. B. Hilton has put it, these governments "broke with physiocracy, autarchy and agricultural expansion."\footnote{20} They dismissed the benefit of public works and denied the permanent effects of a post-war glut. The alliance of Toryism and classical economics was, however, countered by a definite political economy of opposition. The Whigs were left to maintain a radical under-consumptionist theory. Policy prescriptions involved public

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\footnote{18} It is doubtful whether Smith himself would have supported such a purpose. For information on the reception and reinterpretation of Adam Smith's economics in early nineteenth-century political economy see R. D. C. Black, 'Smith's Contribution in Historical Perspective', and Donald Winch's 'Comment' in Thomas Wilson and A. S. Skinner, eds., The Market and the State, Oxford, 1976.


spending and tax reduction. This was an activist policy founded on the basic fear of Malthus that demand might not keep up with production. The machinery question arose on the basis of these two overlapping problems of economic policy – the long-term problem of adjustment to an industrialising economy and the short-term problem of explaining and solving a long series of economic crises. Machinery was considered to be a major component of both these issues of economic policy. The solutions put forward for these problems, though politically motivated, required the emergence of recognisable sets of economic principles. For a set of principles which could account for long-term and short-term economic phenomena would provide the basis for more effective and politically convincing economic policy. The intellectual interest which writers on economic issues may have had in the machinery question was thus complemented by a political interest in explanation and policy. Together, these brought political economy to the fore as the rising academic discipline in vogue in the early nineteenth century, both intellectually and politically.

The popularity of the discipline was not just founded on intellectual and political events. It also had a social base. In the last part of the eighteenth century and very early nineteenth century the economic writings of Adam Smith were taken up in radical intellectual circles and adopted by those interested in political reform. It was the progressive social philosophy that attracted the luminaries of the eighteenth-century literary and philosophical societies and the Jacobin activists. The economy stimulated the imaginations of those such as Thomas Barnes and Thomas Henry who lectured the Manchester Literary and Philosophical Society in the 1780s on the connections between the sciences, the arts, and manufacture. The formulation of economic principles also attracted the interest of the Jacobin sons of the first generation of Lancashire cotton masters. Thomas Walker, Thomas Cooper, James Watt Jr. and Samuel Jackson introduced other young industrialists in Manchester to principles of liberal economic and political reform through reading Adam Smith, Priestley and Bentham in such societies as the Junior Literary and Philosophical Society, the Sciólus Society, and the Weekly Literary and Scientific Society.

This young radical liberal following gave to the origins of political economy a social base that was liberal, middle-class, provincial and industrial. Though this base changed after the first years of the century to encompass the followers of a much more establishment form of liberalism and even of progressive Toryism, political economy never lost its cultural stamp throughout the first half of the nineteenth century. The first social following of this new discipline was one involved even to the grassroots levels in those economic and technological transformations which made the machinery question an issue of such social relevance.

Another slightly later social basis for political economy was provided by the metropolitan radicalism of the Benthamite cause, but this was never to be as extensive as the philosophic radicals hoped. A narrow sectarian group, they aspired to attach Ricardian political economy to their own political doctrines. They attempted this unsuccessfully in the Political Economy Club, and nurtured liberal debating teams for the London Debating Society and the London Co-operative Society. In addition, James Mill took on the role of shaping Ricardo into a parliamentary spokesman for the Benthamite cause.

Ricardo's rise to popularity was helped by an institutional framework. Just as significantly, however, his great prestige changed the character of these institutions. Political economy had many voices during this period, and its institutions – the clubs, journals, and newspapers which helped give definition to the discipline – were not simply avenues for dogma. The Political Economy Club was the most prestigious of these forums. Mallet's diary of the Club's proceedings during this period bears eloquent testimony to the great diversity of interests within the Club. Founded by Tooke and the originators of the Merchant's Petition of 1820, the Club had a practical and not a sectarian character.

A plethora of literary reviews also encompassed political economy in their subject matter. Political economy was popular in both the Edinburgh Review and the Westminster Review. Both, however, practised exclusion of heretical views on political economy at some time. Wide ranging criticism of Ricardian views was kept up by the Quarterly Review, the British Critic, Blackwood's Edinburgh Magazine.

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22 Donald Read, Peterloo, the Massacre and its Background, London, 1958, p. 66.

23 See Political Economy Club, Centenary Volume, 1, 1921, pp. xx–xxi, 3–32.
PART TWO
THE POLITICAL ECONOMY OF MACHINERY

Ricardo's chapter

Ricardo created a new conception of political economy. Against a background of institutional and theoretical diversity in the discipline he moulded an original and unified body of theory. To contemporaries this appeared as a consolidated set of principles so systematic in nature as to be called a science. But it also appeared as a corpus of doctrine so strictly applied and so closely connected to politics and personalities that it became a creed termed Ricardianism.

Ricardo's originality lay partly in his methodology, for his systematic approach to political economy involved the explicit use of models as a basis for explanation. But it also lay in the combination of problems, judgements and conclusions he so effectively combined to provide the authority needed by contemporaries seeking a policy in a very confused economic setting. Ricardo's intervention both in politics and theory provided the connection between appraisal and policy required at the time for the strains of an unprecedented and complicated economic transformation.

The received view of classical political economy in this period emphasises its pessimism. Adam Smith's sanguine affirmation of the implications of the division of labour is contrasted with 'Malthusian' fears of overpopulation, 'Ricardian' predictions of the advent of the stationary state, and the classicals' apparent indifference to the impact of technological change. Schumpeter's criticism and explanation of the 'pessimistic' perspective supposedly to be found in the works of Ricardo, Malthus and Mill are exemplary of many.

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25 B. J. Gordon, 'Criticism of the Ricardian Views on Value and Distribution in the British Periodicals, 1820 to 1850', History of Political Economy, i, Fall 1969; and his 'Says Law, Effective Demand, and the British Periodicals, 1820 to 1850', Económica, xxxii, November 1965.

26 McCulloch, A Discourse on the Rise ... of Political Economy, p. 8.

Those writers lived at the threshold of the most spectacular economic development ever witnessed. Vast possibilities matured into realities under their very eyes. Nevertheless they saw nothing but cramped economies, struggling with ever decreasing success for their daily bread. They were convinced that technological progress and the increase in capital would in the end fail to counteract the fateful law of decreasing returns.¹

In this chapter I shall seek to refute the standard view of Ricardo’s pessimism by a close textual analysis of his writing on technical change, interpreted in the context of his works as a whole. Such an analysis will involve not only the reconstitution of his basic theory, but also the examination of his commentary on contemporary developments. In doing this I follow the essential structure of his Principles, where theoretical chapters on political economy were followed first by those on taxation and policy and then by those making a polemical intervention in contemporary debates. I shall give close attention to Ricardo’s specific remarks on the impact of technical change, and also on its sources and mechanisms. At the same time, reference to the context provided by Ricardo’s work as a whole should make it possible to identify the place of such remarks in his general theory. The task of this chapter will thus be to identify these remarks, to locate their theoretical context, and to assess their significance therein. The result will show just how extreme are interpretations, such as Schumpeter’s, which criticise Ricardo for ‘pessimism’ and for ignoring technological change.

This approach to Ricardo’s work as a whole should then allow an understanding and interpretation of the chapter on machinery which Ricardo added to the third edition of his Principles in 1821. In this very short but provocative piece Ricardo found some reason to support workers who resisted the introduction of new technology. His chapter created a furor of debate among contemporary political economists, and historians of economic thought have equally always found it puzzling. But if it is examined in the context of Ricardo’s work as a whole and in the wider context of the debate on machinery, neither the issues it raises nor its analysis and conclusions would appear to contradict the rest of Ricardo’s work as much as some historians have argued.

Formally, my analysis of Ricardian economics will be divided into separate sections discussing Ricardo’s ideas on the distribution of income and technical change, his view of the process of mechanisation, and his opinions and predictions on the condition and future of machinery and labour.

The distribution of income and technical change
The distribution of income was central to Ricardo’s theories of economic growth. Since Ricardo assumed that all accumulation was derived from profits, the rate of accumulation was determined by the distribution of income between profits and other relative income shares. Technical change was relevant to the distribution of income in so far as Ricardo believed it would offset the effects of diminishing returns, raise profit shares, and thus increase the rate of accumulation.

Some commentators, such as G. S. L. Tucker and Luigi Pasinetti,² have interpreted Ricardo’s theory of income distribution to mean that he did not consider technical change to be an important factor in his economic system. Tucker maintains that Ricardo assumed an economy with no capital-saving innovations and no improvements in technical knowledge. In his view Ricardo only admitted the effects of improvements as modifications at the end of his analysis.³ Pasinetti has gone even further to argue that the law of diminishing returns (that is, the view that, with all other things equal, after a certain point there would be diminishing marginal returns for every increment of investment) was unnecessary. Unnecessary both to the theory of population and to Ricardian rent theory it functions only, he argues, as an analytical tool, making Malthus’s principle of population and Ricardo’s gloomy view of capitalist development impregnable to criticism.⁴

I will argue in this section that such interpretations are not adequate, since they do not explain what purposes and explanatory uses Ricardo envisaged for his model of income distribution. The case I will present can be outlined as follows: Ricardo formulated a strict model of income distribution – a model of what he called ‘natural tendencies’. He then took up the greater part of his Principles specifying the conditions under which such ‘natural tendencies’ came into play and the factors which would limit and prevent such prospects. Ricardo’s model was constructed for particular analytical purposes. These purposes were not,

¹ Schumpeter, History of Economic Analysis, p. 571.
⁴ Pasinetti, ‘From Classical to Keynesian Dynamics’. 
however, the straightforward ones of proving predictive accuracy and explanatory powers.

The Ricardian economic model assumed that land was limited, that there was no technological improvement, and no international trade. In this closed economy model he made rates of capital accumulation and population growth comparable, so that with the expansion of this 'natural economy' real wages would remain the same. The point of Ricardo's exercise in constructing such a model was to allow him to separate the effects respectively of the growth of capital, the rise of population, and the extension of this population to less fertile lands. He wished to analyse just what effect each of these would have in an economy which could expand neither through technological improvement nor international trade.

Under Ricardo's model of the natural economy, the increase of capital and population would have to involve resort to the cultivation of less fertile land. This would lead to a decline in the rate of profit, determined as it was by costs of production on marginal land. Thus economic growth in a closed economy with no opportunities for technological progress would lead to successive reductions in the rate of profit until the point was reached at which there would be no further incentive for investment: in other words, the stationary state. These were, indeed, gloomy prospects. But the question is, how real were Ricardo's fears?

It is interesting to note that throughout his explication of this model, Ricardo wrote of all its components and movements in terms of what was 'natural'. He refers to the 'nature of man' and the 'natural limits to population growth'. There was a 'natural price of labour' and a 'natural price of commodities'. The 'natural operation of the proportion of supply and demand' went with the 'natural advance of society' and the 'natural tendency of profits to fall'. The dynamic of the economy would gravitate to the operations of the 'laws of nature'.

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I will argue that Ricardo, in fact, drew a sharp distinction between this 'natural world' and the socio-economic world he was attempting to analyse. This model of 'natural tendencies' had a negative purpose. It was a counterfactual, set up precisely in order to emphasise the significance of the factors from which Ricardo abstracted - free trade and technological improvement. The model thus drew attention to these two vital means of escaping the restraints imposed on the rate of capital accumulation by limited land and excessive population growth. Trade and technical progress both produced social and economic changes which considerably modified the 'natural state' of limited land.

Ricardo made his views on the role of both factors quite clear even in his first outline of the strict model in his *Essay on Profits* of 1815. For he concluded this *Essay* with the comment: 'I shall greatly regret that considerations for any particular class, are allowed to check the progress of the wealth and population of the country.' If the interests of the landlord against the free importation of corn were to be allowed, 'let us by the same act arrest improvement, and prohibit importation'.

The model of 'natural tendencies' made the effects of carrying out such acts crystal clear.

Ricardo's purpose in using such a model to demonstrate certain practical and empirical points must, however, be distinguished from his longer run vision of economic growth. For Ricardo did believe that the expansion of an economy faced ultimate limits in the effects of two tendencies: excessive population growth and diminishing returns. He did not, however, attach very much empirical significance to these tendencies, and regarded the limits they imposed on economic expansion in purely analytical terms. In using these tendency statements and seeking the limits of his analysis Ricardo was simply stating some basic axioms on which to base a contingency prediction: this was a method familiar to strict logical argument. He also maintained these assumptions in order to bring them into play to explain the inducements to technological change and the drive to expand markets. I will discuss this in more detail in the third section of this chapter, 'Technical change: mechanisms and processes.'

A number of historians have begun to emphasise the particular purpose of Ricardo's model of distribution in relation to contemporary policy concern with international trade. Both Mark Blaug and Maurice Dobb have argued that its significance is only to be understood in the

context of the Corn Laws. Blaug has pointed out that hindrances to foreign trade were major conditions prompting a tendency for the rate of profit to fall. The stationary state was therefore, he argues, Ricardo's 'methodological fiction': 'The alleged “pessimism” of Ricardo was entirely contingent upon the maintenance of the tariff on raw produce . . . the notion of an impending stationary state was at most a useful devise for frightening the friends of protection.' Dobb gives additional emphasis to the importance Ricardo attached to foreign trade. He cites Ricardo's argument in his article in the Encyclopaedia Britannica that, if food and raw materials were supplied from abroad in exchange for manufactured goods, 'it is difficult to see where the limit is at which you cease to accumulate wealth and to derive profit from its employment.' He uses an even more forceful statement in a letter by Ricardo to Trower in 1820: 'I contend for free trade in corn on the ground that while trade is free, and corn cheap, profits will not fall however great be the accumulation of capital.' Such evidence vindicated Edwin Cannan's judgement that 'as a basis for an argument against the Corn Laws it would have been difficult to find anything more effective than the Ricardian theory of distribution.'

In fact these were not only Ricardo's programmatic and personal opinions, they were equally to be found in the argument of the Principles. In the chapter on profits he distinguished the future of an 'extensive country with land of poor quality and where the import of food is prohibited', from that of 'small fertile countries' with free import of food. In the first, even a very small accumulation of capital would result in a fall in the rate of profit and a greater rise in rents.

More recently, Samuel Hollander has sought to restrict the significance of Ricardo's distribution model still further by arguing that even in the absence of Corn Law repeal Ricardo was optimistic about Britain's growth prospects. He was sufficiently confident of the dynamic growth of the economy and continued capital formation to play down the adverse effects of the Corn Laws and the Poor Law. Hollander draws attention to the dispute between McCulloch and Ricardo over the latter's speech to the House of Commons in March 1821. Ricardo's speech minimised the negative effects of agricultural protection upon the rate of domestic accumulation. McCulloch, by contrast, regarding himself as a carrier of Ricardian orthodoxy, insisted that the great source of Britain's difficulty lay in a low rate of return due mainly to the Corn Laws. Hollander notes the significance Ricardo attached to the allocation of capital and influences on accumulation, and argues that part of the explanation for his optimism is to be found in his recognition of agricultural innovation and the effects of technological progress in manufacturing. Hollander points out that technical change may have mattered to him as much as did foreign trade. I will now make the case that Ricardo did indeed attach a significance to technical change at least equal to that he gave to foreign trade.

The interpretations of Blaug, Dobb, and Hollander of the contextual framework of Ricardo's theory significantly modify the import of the Ricardian models of distribution and accumulation. If, as I have argued above, the theoretical implications of Ricardo's restrictive models were meant to be negative, precisely in order to emphasise the practical significance of those factors from which he abstracted, then technical change as well as free trade would be prominent features in his dynamic forecasts.

In several places Ricardo clearly emphasised that the effect of machinery was similar to that of foreign trade. If the introduction of cheap foreign goods reduced costs of production and therefore lowered value, then technical change had an analogous effect. If cheap foreign goods lowered the costs of labourers' subsistence, thus reducing the wage share and bringing about a rise in profits, then so also did the extension of machinery. Blaug and Dobb have shown that Ricardo's well-known intervention in the debates on the Corn Laws may reasonably influence the interpretation of his model of distribution because of the intimate connection between this policy context and his theoretical analysis of foreign trade. Hollander, though sceptical of the importance Ricardo attached to the repeal of the Corn Laws, likewise argues that Ricardo did not draw conclusions pessimistic of Britain's growth prospects from his theoretical growth model, and that he was well aware of the real 'dynamism of the British economy', despite protection. I would now add to these studies the suggestion that there was an

14 Edwin Cannan, cited in Dobb, Theories of Value, p. 90.
15 Ricardo, Principles, p. 126.
equally important connection between Ricardian theory and its public context in the case of technical change and the machinery debates.

We must first consider the explicit examination made by Ricardo of the impact of technical change, both in agriculture and industry, on distributive shares.

Even in his earliest writings Ricardo drew attention to improvement: "If by foreign commerce, or the discovery of machinery, the commodities consumed by the labourer should become much cheaper, wages would fall; and this, as we have before observed, would raise the profits of the farmer, and therefore, all other profits." In addition, such improvements would 'lower for a time rents'. Wage and rent shares would also fall and the profit share would rise if capitalists simply reduced their levels of investment. For in the economy with no technological improvements, high levels of investment placed strains on the market for land and labour, forcing the extension of cultivation to less productive land and raising the costs of workers' subsistence. The remaining profit share would therefore be correspondingly reduced. In such circumstances the only means of maintaining a share of profits sufficient to prevent the onset of the stationery state was to introduce measures preventing high rates of accumulation. Retrogression of this kind was not, however, necessary to maintain the rate of profit, and Ricardo emphasised this in the first edition of the Principles: "The same effects may, however, be produced, when the wealth and population of a country are increased, if that increase is accompanied by such marked improvements in agriculture, as shall have the same effects of diminishing the necessity of cultivating the poorer lands, or of expanding the same amount of capital on the cultivation of the more fertile portions."

Ricardo thus envisaged two types of capital accumulation. The first took place in a situation of no technical change. When capital was accumulated without technical change, its labour cost of production, that is, its value, also rose. Such accumulation demanded a widening of the margins of cultivation and with it a rise in costs of production overall, since costs were determined at the margin. Relative wage shares thus rose and profit shares fell. Ricardo's second type of capital accumulation can be described as capital-embodied technical change. In this situation a capital stock could rise, while its value could simultaneously fall. Additions to capital need not entail the extension of the margin of cultivation, for they could be made by the aid of machinery. This would prevent any rise in necessary proportions of labour, and the wage share could stay the same or fall. In order to understand more precisely the complexities of the impact of technical change on distributive shares, it will be necessary to examine in turn wages, profits, and rent.

The critical variable in the whole process of accumulation was the share of wages. What did Ricardo mean by the share of wages, and why did a high share of wages seem to be an indication of regression in the economy? The wage share was an aggregate of what Ricardo termed the natural wage, as distinct from the 'market wage'. The natural wage was the cost of workers' subsistence. Ricardo's definition of subsistence was not simply literal. It had a 'social' element, being dependent on the 'habits and customs of the people'. Nevertheless, whatever the level of 'social' subsistence, the natural wage still had to be considered first in relation to the cost of food. For it tended to rise with diminishing returns in agriculture, and the consequent increase in food prices. If capital accumulation should occur unaccompanied by technical change, and hence without offsetting diminishing returns in agriculture, then the natural wage share would rise. But, in fact, most capital accumulation was accompanied by some improvements in technique which would prevent that eventuality.

The natural price of all commodities, excepting raw produce and labour, has a tendency to fall, in the progress of wealth and population; for though, on the one hand, they are enhanced in real value, from the rise in the natural price of the raw material of which they are made, this is more than counterbalanced by the improvements in machinery, by the better division and distribution of labour, and by the increasing skill, both in science and art, of the producers.

The wage share, of course, was also important to the condition of the working classes. However, their actual condition was dependent, not on the natural wage, but on the differential between this and the market wage. In the process of capital accumulation and economic shares...
growth the latter would rise relative to the former, but the permanence of any increased differential between them was of course also dependent upon the movements of the natural wage. Where capital accumulation took place without technical change, marginal costs of production would ultimately rise. Any such rise in costs would also increase the share of national income required by natural wages. And high wage shares caused by a rise in the cost of subsistence would nullify the earlier gains made by increasing the differential between natural and market wages through gains in the latter. Ricardo could therefore derive from his model the conclusion that technical change could improve the condition of the working classes, by preventing a rise in the share of natural wages.

However, Ricardo still held strong doubts about the permanence of any gains to the wage-earning classes. Though technical change could prevent a rise in the costs of the subsistence wage, high market wages and a wide differential between market and natural wages would provide an incentive for population growth. Ricardo endorsed Malthusian population assumptions, and accordingly believed that any differentials that arose between market and natural wages would soon be liable to elimination by the effects of population growth.

On the other hand, Ricardo recognised that higher natural wages need not carry a negative connotation. For such gains in the natural wage could arise, not only from a higher population or higher cost of production, but from gains in the levels of social subsistence.

The friends of humanity cannot but wish that in all countries the labouring classes should have a taste for comforts and enjoyments, and that they should be stimulated by all legal means in their exertions to procure them. There cannot be a better security against a superabundant population. In those countries, where the labouring classes have the fewest wants, and are contented with the cheapest food, the people are exposed to the greatest vicissitudes and miseries.  

Ricardo not only believed that a high natural wage could have this positive implication, but he thought that there was no practical necessity for a convergence between market and natural wages. In an ‘improving society’ market wages could stay indefinitely above natural wages, ‘for no sooner may the impulse, which an increased capital gives to a new demand for labour be obeyed, than another increase of capital may produce the same effect’.  

If this differential between market and natural wages could be maintained for any length of time, either through the effects of an increase in capital acting on the market wage, or through the effects of technical progress on the natural wage, then it would create incentives for a change in the levels of necessary social subsistence. Goods which were formerly luxuries could become new needs, and, by this means, social subsistence wage levels could rise. A rise in the social subsistence or natural wage need not, therefore, reflect an increase in population. It could in fact, by reducing the differential between market and natural wages, have the effect of reducing population growth. This type of increase in natural wages brought great gains to the condition of the working classes. It was therefore in sharp contrast to the increase in the natural wage share brought about by rising population and rising marginal costs.

Ricardo noticed, moreover, that technical change not only affected the level of social subsistence, but also affected the composition of that subsistence. The extent to which technical change brought about a substitution of manufactured for agricultural goods in the wage basket had very real significance for the impact of the law of diminishing returns. Ricardo explicitly dissociated himself from the view he attributed to both Smith and Malthus, that the wage basket consisted entirely of corn, so that population and profits could be tied entirely to the provision of food. That the wage basket might tend increasingly to consist of more than food followed from the very logic of Ricardo’s model of accumulation: ‘From manufactured commodities always falling, and raw produce always rising, with the progress of society, such a disproportion in their relative value is at length created, that in rich countries a labourer, by the sacrifice of a very small quantity only of his food, is able to provide liberally for all his other wants.’ The fact that workers could and did buy manufactured goods limited the impact

24 Ibid. pp. 100-1.

25 Ibid. p. 95.

26 Ibid. pp. 293 and 406-7; Notes on Malthus’s Principles of Political Economy, in Ricardo, Works, vol. 11, p. 115. Ricardo is perhaps commenting on this in his reaction to the possibility of a glut of necessaries. He replies, ‘could such a state of things exist? Would only such a limited number of commodities be produced? Impossible, because the labourers would be glad to consume conveniences and luxuries if they could get them,’ Notes on Malthus, p. 312.

27 Ricardo, Principles, p. 97.
over the whole economy of diminishing returns in the agricultural sector. Ricardo, as Samuel Hollander has shown, recognised this even before his *Essay on Profits.*28 Ultimately the wage was the crucial variable, not the price of corn. It is this attention which Ricardo gave to the composition of the wage basket that led him to a very ambivalent position on the Malthusian population theory. Ricardo's *Notes on Malthus* show that he found the Malthusian principle too crude theoretically,29 but he endorsed the general dogma.30 His ambivalence shows even more clearly in the *Principles* where he argued that high wages need not necessarily lead to population increase.

The amended condition of the labourer, in consequence of the increased value which is paid him, does not necessarily oblige him to marry and take upon himself the charge of a family — he will, in all probability, employ a portion of his increased wages in furnishing himself abundantly with food and necessaries, — but with the remainder he may, if it please him, purchase any commodities that may contribute to his enjoyments — chairs, tables, and hardware; or better clothes, sugar, and tobacco.31

Ricardo, however, stopped at this point and conceded the argument to Malthus. In the same paragraph he concluded:

But although this might be the consequence of high wages, yet so great are the delights of domestic society, that in practice it is invariably found that an increase of population follows the amended condition of the labourer; and it is only because it does so, that, with the trifling exception already mentioned, a new and increased demand arises for food. This demand then is the effect of an increase of capital and population, but not the cause — it is only because the expenditure of the people takes this direction, that the market price of necessaries exceeds the natural price, and that the quantity of food required is produced.32

Still, though Ricardo endorsed Malthusian assumptions on the inducements to population growth, it is doubtful if he was as apprehensive of overpopulation as were many of his contemporaries. Hollander goes so far as to argue that Ricardo regarded the rapid contemporary growth rate of population as necessary to meet the even greater rate of increase of capital. Hollander cites Ricardo's comment that the pernicious effects of the Poor Laws had, for this reason, not been felt in the context of a rapidly expanding capital and growing economy. He argued, 'Happily these laws have been in operation during a period of progressive prosperity, when the funds for the maintenance of labour have regularly increased, and when an increase of population would be naturally called for.'33 The 'pernicious nature of these laws' would only become clear with the approach of the stationary state.

Ricardo's discussion of profits and technological improvement was based almost entirely on what he had to say about wages. Technical change did not have a direct impact on the rate of profit. Indeed, profits changed, in any circumstances, only in response to developments in the sector producing goods for the consumption of wage earners. Technical change could thus be said to raise the rate of profit only to the extent that it reduced the costs of 'wage goods'. Any change in techniques which affected only luxury goods consumed by capitalists and landlords could induce no change at all in the rate of profit. In an extreme situation, where wage earners consumed only corn, technical change in the industrial sector could affect prices, but not the rate of profit.

The rate of profit is never increased by a better distribution of labour, by the invention of machinery, by the establishment of roads and canals, or by any means of abridging labour either in the manufacture or in the conveyance of goods. These are causes which operate on price and never fail to be beneficial to the consumers, . . . but they have no effect whatever on profit. On the other hand, every diminution in the wages of labour raises profits, but produces no effect on the prices of commodities.34

Perhaps one of the most longstanding and polemical concerns of the issues arising from Ricardo's work on technology and distribution was

28 Samuel Hollander, 'Ricardo's Analysis of the Profit Rate 1813 to 1815', *Economics,* xi., August 1975, pp. 282.
30 Ibid. p. 262
32 Ibid. p. 407. The first edition did not refer to this as a 'trifling exception'.
that of the impact of improvements on rents. From his early corn model through to the propositions of his *Principles*, Ricardo argued that the necessary effect of both improvements and free trade in corn was the reduction of rents. The proof took on the political form that the interest of the landlord was opposed to that of every other class of the community.35

The level of rent on any one piece of land was established by the differential productivities of successive capital inputs. Because Ricardo assumed diminishing returns, there was a point beyond which each successive capital input generated a lower return than the previous one. Rent was determined by the difference between the return on the most recent and least productive capital input and the previous and marginally more productive capital input. Rent therefore established at the margin of cultivation, and was high or low according to the levels of capital accumulation required. When some event occurred which had the effect of reducing the level of required capital accumulation, this would allow for a retreat in the margin of cultivation, and therefore in a reduction in the differentials or inequalities in the products obtained from each successive capital input on the land. Because the margin of cultivation had moved inwards and the capital costs of cultivation had fallen, rents too would fall.36 Agricultural improvements and free trade in corn were major rent-reducing factors. Both allowed for either the cultivation of more land and the production of a greater output with the same capital, or for an actual reduction of land in cultivation and therefore capital accumulation in order to produce the same output. The logical conclusion of any association between agricultural improvements or freer trade and lower rents was that landlords would be against all such changes. The polemical implications Ricardo drew from this finding were, however, unacceptable to many of his contemporaries.

Malthus, in particular, continually disputed Ricardo’s enmity to landlords. However, Ricardo never looked on the inverse relation between rents and agricultural improvements as anything but a short-term interim effect. Sraffa has argued that Ricardo merely added a footnote in the third edition of his *Principles* conceding some ultimate benefit to the landlord.37 But even in his polemical chapters against Malthus and the Corn Laws Ricardo had conceded that the landlord did have a long-term interest in agricultural improvements: “The machine which produced the most important article of consumption would be improved, and would be well paid for according as its services were demanded. All the advantages would, in the first instance, be enjoyed by labourers, capitalists, and consumers; but with the progress of population, they would be gradually transferred to the proprietors of the soil.”38

Ricardo most emphatically denied the charge of dissociating landlords from the gains of economic growth in his *Notes on Malthus*:

Perhaps in no part of his book has Mr. Malthus so much mistaken me as on this subject—he represents me as supporting the doctrine that the interests of landlords are constantly opposed to those of every other class of the community, and one would suppose from his language that I considered them as enemies to the State. . . . All I meant to say of the landlord’s interest, was, that it would be for his advantage that the machine which he had for producing corn should be in demand—that in fact his rent depended on it—that on the contrary it was the interest of the consumer to use the foreign machine, if that would do the work cheaper. It is only in this case, that the interests of the landlord and consumer really, if well understood, come in contact. . . . I have indeed observed that improvements in agriculture were in their immediate effects injurious to the landlord, . . . Great improvements in any branch of production are in their first effects injurious to the class who are engaged in that branch, but this is the statement of a fact or an opinion, and cannot be supposed to cast any injurious reflections.39

Ricardo, therefore, associated rising rents with the general tendency of capital accumulation, but with the proviso that this abstracted from technical change. The initial impact of technical change in agriculture, ceteris paribus, was to reduce rents. However, Ricardo went on to suggest that in a prosperous improving economy the advantages of technical progress might be enjoyed first by labourers, capitalists, and consumers, but they would soon also be enjoyed by landlords. Here he brought the population principle to bear, for an economy would only continue to improve because of constantly increasing demands created either by an expanding population or by new needs. Where cultivation was extended in spite of improvements, which was a likely situation in

38 Ricardo, *Principles*, p. 335; also see p. 419.
a growing economy, then rents too might rise. Ricardo drew a
distinction in this, as in other cases, between the results of his restrictive
model, and his conception of the overall growth process.

Technical change: mechanisms and processes
I have shown that Ricardo’s model of distribution gave remarkable
illumination to the significance he attached to technical change. His
model, which demonstrated the eventuality of the stationary state but
for the social and economic effects of technical improvement and free
trade, was by no means a pessimistic one. On the contrary, it was a
highly systematic and very optimistic presentation of the extent of the
gains to be had through technological improvement and freer trade.
In addition to this, Ricardo also had a number of ideas about the
processes of technical change. Not formally integrated with a model of
economic growth, these have often been missed by commentators
sceptical of Ricardo’s recognition of the importance of technical
improvement to the economy of his day.

The sceptics have generally pointed to several gaps in Ricardo’s
perceptions of technical change. They claim that Ricardo did not take
up Smith’s discussion of the division of labour, and that he did not make
clear the distinction between capital-saving and labour-saving tech-
niques. They further believe that his model did not have built into it
a concept of self-generating technical change as did Smith’s, where
the division of labour was embodied in new techniques, or Marx’s, where
the drive to technical change was incorporated in the tendency to the
rising organic composition of capital. However, these and other factors
were discussed by Ricardo, though not in any strictly systematic
fashion. He adapted the concept of the division of labour to his own
purposes. He drew attention to the structure of capital, and understood
the implications of the capital or labour intensities of various technolo-
gies. He investigated the ways in which the introduction of machinery
saved on capital, and explored the extent of choice available in the
introduction of new techniques. He examined the progressive potentials
in the agricultural and manufacturing sectors, and assessed the types
and relative merits of technological improvement in both. Finally, he
looked at inducements to gains in labour productivity and also gave a
place to the role of good government in promoting improvements.

Ricardo did not attempt to develop in more detail Smith’s concept
of the technical division of labour and it is likely that he simply took it
for granted. What he did do, however, was to adapt the concept to his
own purposes, to help to explain the gains from international special-
isation in production. He gave much more detailed attention to the
structure of capital and extended this to the relative capital- and
labour-intensities of various techniques. He defined quite early on in his
work his notion of capital, and the criteria for its separation into its
fixed and circulating elements. Capital was generally defined as time
and was fixed or circulating according to its durability or the time it took
to consume. But, as Ricardo noted, the division was one ‘not essential,
and in which the line of demarcation cannot be accurately drawn.’
As he was to point out later, however, the division was actually very
important. The employment impact of capital accumulation was a
function of the proportions embodied in fixed and circulating elements.
I will discuss this in greater detail in the final section of this chapter on
machinery and labour.

Ricardo went on from this analysis of the structure of capital to
argue that the introduction of machinery could in part be explained
by the existing composition of capital. To explain this he deployed his
limiting assumptions of rising rates of population growth and diminish-
ing returns to explain a tendency towards rising proportions of
machinery to labour over time. Rising rates of population growth and
diminishing returns, even if seen as limits on economic expansion in
only the last analysis, might still seem to threaten the unimpeded course
of future economic growth. As threats they made the drive to overcome
economic necessity one of the major inducements to technical change.
Technical change was thus seen as a response to the pressure of a distant
tendency to rising rates of wages in old and wealthy nations. Using
these assumptions, Ricardo first analysed the inducements to and effects
of capital saving techniques. The introduction of machinery or the
increase in fixed capital could save on total capital, for he regarded
machinery as the product of less labour than that which it displaced.
A rise in wages would also have a greater effect on the value of com-
modities produced by circulating capital than on those produced by
fixed capital: ‘Through their [machines’] influence an increase in the
price of provisions which raises wages, will affect fewer persons . . .
and the saving which is the consequence shows itself in the reduced
price of the commodities manufactured.’ The introduction of this fixed
capital saved on total capital. Thus, ‘neither machines, nor the com-

40 Ibid. p. 159.
41 Ricardo, Principles, p. 52.
modities made by them rise in real value, but all commodities made by machines fall, and fall in proportion to their durability'.

Second, this peculiar effect of the introduction of machinery, as well as the influence of differing comparative capital structures, were issues which led Ricardo to take up discussion of the choice of techniques. He pointed out the impact of factor prices such as the rates of wages and interest on the introduction of new technologies. Ricardo connected the tendency of wages to rise relative to interest rates to a tendency to rising capital intensity in industry. Thus he argued:

In the distribution of employments amongst all countries, the capital of poorer nations will be naturally employed in those pursuits, wherein a great quantity of labour is supported at home, because in such countries the food and necessaries for an increasing population can be most easily procured. In rich countries, on the contrary, where food is dear, capital will naturally flow, when trade is free, into those occupations wherein the least quantity of labour is required to be maintained at home.

Moreover, in the process of economic growth without substantial innovation there was an increasing tendency for wage shares to rise and 'with every rise in the price of labour, new temptations are offered to the use of machines'. It was with this in mind that Ricardo came to find acceptable John Barton's argument that 'as arts are cultivated, and civilization is extended, fixed capital bears a larger and larger proportion to circulating capital'. Ricardian theory contained the embryonic prediction of the fully mechanised economy.

Yet, factor prices were also the major determinants of the slow diffusion of technical innovation. Ricardo explained the slow diffusion of new techniques by low relative wages. It is thus that we understand his image of the American economy as a relatively labour-intensive economy. The choice of techniques was, in Ricardo's words, 'the constant competition' of 'machinery and labour'. We here see why it is that old countries are constantly impelled to employ machinery, and new countries to employ labour. With every difficulty of providing for the maintenance of men, labour necessarily rises, and with every rise in the price of labour, new temptations are offered to the use of machinery. In such old countries, among which he included Britain, Ricardo recognised that technical change rather than simple capital accumulation was the faster and more painless road to economic growth.

Ricardo's analysis of the choice of techniques became more refined as he pushed on to examine the differing potentials for technological improvement in agriculture and manufacturing. He generalised that in the course of economic growth manufacturing would come to assume larger proportions of the national economy. In a speech in 1822 he declared:

The hon. gentleman might, perhaps, think that a manufacturing country could not be so happy as an agricultural country. But he might as well complain of a man's growing old as of such a change in our national condition. Nations grow old as well as individuals; and in proportion as they grow old, populous and wealthy must they become manufacturers. If things were allowed to take their own course, we should undoubtedly become a great manufacturing country, but we should remain a great agricultural country also.

He was also sensitive to the fine divisions and types of change in techniques which were particular to each sector. He did not regard agricultural improvements as just another variation on improvements in the manufacturing sector, for he identified two types of improvement in the agricultural sector each of which had very different implications. One type of improvement added to soil fertility by better crop rotation or the use of fertilisers; this land-saving innovation reduced real rents. The second type of improvement raised capital and labour productivity, but the effectiveness of this capital-saving improvement was limited by physical diminishing returns.

The analysis of improvement in the agricultural sector clarified

43 Ibid. p. 49.
44 Ibid. p. 41.
46 Ibid. p. 396.
48 Ibid. p. 41.
49 Ibid. p. 397.
Ricardo's choice of the key dynamic factors in growth. It was, furthermore, the style of improvement in this key sector which was fundamental to the rate of capital accumulation. This rate depended in the first instance on labour productivity and the fertility of the soil. Ricardo agreed with Smith that in new settlements 'where the arts and knowledge of countries far advanced in refinements are introduced', the rate of capital accumulation exceeded the rate of population growth.\(^{81}\) Labour productivity, however, was equally dependent on capital formation, and Ricardo therefore reproved Malthus for comparing the labour productivity of various nations on the basis of the inclination to work. Such criteria completely neglected relative levels of capital formation.\(^{82}\)

Labour productivity, as I noted earlier, was central to Smith's conception of the growth process. It is popularly believed that, in contrast with Smith, Ricardo was so entrenched in a model based on the accumulation of capital that he ignored the significance of labour productivity. Here one can see, however, that Ricardo carried over the spirit of Smith's ideas by seeing labour productivity along with the fertility of the soil as factors affecting the rate of capital accumulation. Ricardo not only sought to explain national differences in labour productivity, but also to dissect this productivity by inquiring into skill. Labour productivity depended on comparative levels of skill, which in turn were related to comparative levels of capital formation. Ricardo, unlike Smith, did not regard skill as an attribute given by the division of labour. Skill was instead a capital good, provided by the labourer. Skill was 'dependent on the interests of the masters may feel to give their children this dexterity and ingenuity', and the supply of such labour depended on the costs of conferring this dexterity.\(^{83}\) The subsistence of labour was regarded as providing not only for the continuity of the day-to-day labour of a worker and his descendants, but for the production of more and more complex and skilled labour.

Finally, Ricardo also conceived a definite role for good government in the direction of capital accumulation and growth. Again, like Smith, he distinguished badly governed from well-governed nations.

In those countries where there is abundance of fertile land, but where, from the ignorance, indolence, and barbarism of the inhabitants, they are exposed to all the evils of want and

famine, and where it has been said that population presses against the means of subsistence, a very different remedy should be applied from that which is necessary in long settled countries, where, from the diminishing rate of the supply of raw produce, all the evils of a crowded population are experienced. In the one case, the evil proceeds from bad government, from the insecurity of property, and from a want of education in all ranks of the people. To be made happier they require only to be better governed and instructed, as the augmentation of capital, beyond the augmentation of people, would be the inevitable result. No increase in the population can be too great, as the powers of production are still greater.\(^{84}\)

The transfer to good government in such a country would involve higher rates of capital accumulation benefiting all.\(^{85}\)

Ricardo's comments on the government of nations did not stop with this judgement on the problems of young nations. For he also believed that government had a great deal to do with the difficulties of old nations, notably England. In arguing that older nations would tend to become manufacturing nations, he had taken care to add, 'If things were allowed to take their course, we should undoubtedly become a great manufacturing country, but we should remain a great agricultural country too.' In this speech Ricardo was not only making the point that the rising dominance of the manufacturing sector was inevitable for the British economy – he was arguing that it was desirable. The implication was that things were not being 'allowed to take their course' because they were being held back by government. Ricardo was issuing his warning to policy makers that a nation which expanded its capital and its population without the benefit of international trade and technical improvement would soon find itself on the road to falling rates of profit and an imminent stationary state.

Furthermore, Ricardo was not just preaching to a society still dominated by the landed interests; he was preaching to a government which was equivocal if not hostile to the current rapid progress of industrialisation. I would argue that Ricardo was deploying his economic analysis not to represent the manufacturing as opposed to the landed classes but to replace a dominant ideology of economic policy. His analysis of a progressive continuously transforming economy was in stark contrast

\(^{81}\) Ricardo, *Principles*, p. 98.
\(^{82}\) Ricardo, *Notes on Malthus*, p. 87.
\(^{83}\) Ibid. p. 226.
\(^{85}\) Ibid. pp. 99–100 and 100n.
to the assumptions of a static self-regulating economy then underlying government policy.

Boyd Hilton in *Corn, Cash, Commerce* has demonstrated that the so-called liberal Tory governments of 1815 to 1830 dominated by Lord Liverpool and Huskisson were not particularly concerned for the expansion of industry and commerce. They sought to feed and to employ a rapidly expanding population, but saw themselves doing so within a finite international economy currently under the strain not of industrialisation but of the consequences of war and monetary depreciation.

Industrialisation could not be accommodated within the terms of debate known by these policy makers. When they decided on the return to the gold standard in 1819 it was interpreted as a restoration of the currency to its pre-war or 'natural' state. The policies of the liberal Tories were inspired, as Boyd Hilton has expressed it, not by a belief in utilitarianism but in 'naturalness'. Though they recognised that the economy must not be allowed to retrogress, they also maintained that growth must be confined to 'legitimate bounds'. For 'overstepping the natural level of economic activity would cause overproduction and gluts'.

Ricardo's model of 'natural tendencies' which so incisively traced out the connections between natural prices, laws of nature and natural tendencies of rates of profit to fall, seemed eminently suited to analysing an economic policy which assumed legitimate levels of economic activity and natural states for the economy. Ricardo's strict model of income distribution was a negative model in the sense that its purpose was to demonstrate the importance of trade and technical progress by analysing an economy which lacked these. However, it was also a model which can be seen as effectively encapsulating the basic assumptions of the current economic policy, and proceeding to analyse the dire and gloomy prospects of continuing on the basis of a belief in legitimate and natural paths to stability.

These governments did introduce a number of free trade reforms and often justified these by referring to political economy. But such justifications were in the main opportunistic. Boyd Hilton shows how in agricultural trade policy their main interest was in the best guarantee of subsistence, and they endorsed protection, then free trade accordingly. I will outline in Chapter 9, 'The Export of Machinery', the extent to which their industrial trade policy was also based on expediency and not theory. Ricardo cannot be neatly summed up as one who provided a theory which was obviously influential to a willing government carrying forward the interests of the rising manufacturing classes. Ricardo's *Principles* put forward a new ideology of economic and technological improvement - if not of limitless growth, then of growth to which an empirical limit could not yet be set. But he was a missionary in a land of pagan naturalists.

*Machinery and labour*

Ricardo's interest in the connections between a country's capital structure and its technology did not at first go any further than a few remarks on inter-country comparisons of economic development and explanations for existing techniques and trade patterns. However, he soon came to realise that the composition of capital in a country, and through this its choice of a suitable technology, could have important implications for employment. His chapter on machinery, the only significant change in the third edition of his *Principles*, detailed his recognition of the employment impact of a change in techniques. Ricardo's change of view did not have purely theoretical implications, for the problem could not be separated from the contemporary debate on machinery and labour.

This chapter represented a fascinating and provocative development in Ricardo's economic theory, and the findings he described there seemed to be at variance with the optimistic perspectives he offered on technology throughout the rest of the book. Furthermore, its claims appeared to be so directly addressed to a central issue of public debate, that theory and politics must have been closely entwined. In this one small section of the *Principles* Ricardo presented his readers with the political economy of radicalism, reaction, and liberalism of his own time. It is a chapter which can only be understood through a historical interpretation, for it touched on a contemporary issue which was far-reaching in its social significance.

When Ricardo publicly announced the change he had made in his opinions on machinery he said that though he had not published anything on the subject, 'yet I have in other ways given my support to doctrines which I now think erroneous'. This probably referred to the part he took in the anti-Owenite campaign about which I will say more below. However, Ricardo had also referred to labour-saving machinery

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explicitly in his *Essay on Profits* where he argued that the impact of a low price of corn on the working classes 'would be nearly the same as the effects of improved machinery, which it is now no longer questioned, has a decided tendency to raise the real wages of labour'. In the first edition of the *Principles* Ricardo had taken this for granted, and only recognised capital transfer costs. It is also true that even when something other than an Owenite argument for technological unemployment was put to him, Ricardo was similarly unimpressed. Ricardo's early reaction to John Barton, whose work he came later to endorse, bears this out. In answer to Barton, Ricardo simply asserted that the accumulation of fixed capital would not have any adverse impact on employment. The quantity produced over and above necessary consumption would be the same in both cases. Moreover, he regarded the possibility of technological unemployment as highly unlikely: 'The case is evidently put for the sake of argument, and could not really take place, for there is no new creation of machinery which entirely supersedes the use of the labour of man. A steam engine requires the constant labour of man – he must regulate its motion and velocity – he must procure coal for the fire necessary to work it – he must attend to its annual repairs.'

Ricardo repeated his general reaction when he commented on McCulloch's partial endorsement of Barton's theory of technical change.

Ricardo's change of mind, as embodied in the third edition of his *Principles*, took place when he came to consider not simply the effect of technical change in a situation of gradual and balanced growth but also the case where a change in techniques involved a strong switch to fixed capital. He discovered that where the introduction of such new technology took place in a situation of capital scarcity there would probably have to be a change in the composition of a country's capital stock. A country's stock of circulating capital would have to be reduced in order to raise a stock of fixed capital sufficient to introduce the new technique. But its level of employment was dependent upon its circulating capital, that is its wage goods and materials. If capital was shifted from the production of wage goods to the construction of machinery, then employment over the whole economy would have to fall. There were several implications of such a change in the composition of capital during the construction period of new machinery. The first was that final output could actually fall during this period, as wage goods were definitely a part of the final output. The second was that the whole stock of capital could actually rise at the same time that circulating capital and final output were falling. For, though circulating capital was being transferred to the construction of fixed capital, the new machines could add to the capital stock by more than the reduction in circulating capital. Finally, inventions could be labour saving, not for any one industry or sector, but for the economy as a whole. During a construction phase total employment could actually fall because of the decline of circulating capital and final output both of which would reduce the demand for labour. However, as Ricardo emphasised just as strongly, these eventualities were only possible during a time of construction and rapid accumulation of fixed capital. As soon as the new machine came into operation such high costs of accumulation would be compensated by the lower labour or 'circulating capital' input required in running the new machines. This would seem at first sight only to add to the level of unemployment. But it was not so. For the fact that labour was displaced from the sector using the new machines would lead to lower costs of production, and therefore create a surplus which would in turn create the means for re-employing labour in other sectors.

Ricardo did not believe that technological unemployment must be the necessary result of any change in techniques in a particular industry. It did not occur because a machine replaced a labourer, but rather, because investment in machinery had to claim priority over the production of final output. Technological unemployment would therefore only take place in those extreme situations where a country's capital was very scarce and where the construction of the new machines demanded a strong switch to fixed capital. Ricardo's analysis was an original one, distinct from the case made by many of his contemporaries. Where others maintained merely that machines displaced labour in any industry where they were introduced, Ricardo claimed that the replacement of men by machines in particular industries need not extend any further. In fact, the displacement of labour in one industry, by increasing productivity, might compensate for a form of technological unemployment which arose from the quite different causes of capital scarcity and sudden changes in the composition of capital. The lower labour or circulating capital input required in the operation of the new machines in any one sector would generate a surplus to re-employ labour in other sectors. The new machines or fixed capital

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stock, once accumulated, would generate gains in productivity and therefore increase the surplus. Rising rates of growth would release the strains on saving in the original capital scarce economy, and would ultimately result in higher levels of capital and a rising demand for labour. Ricardo confined the time of difficulty to the period of accumulation prior to the full operation of the new machines. The crucial problem lay in the possibilities of labour-saving effect which extended over the economy as a whole — that is, an interim period when capitalists expected to invest in machinery, and to gain themselves the same return, yet to produce for a time a smaller final output. After this interim period there ought to be no further restriction of this nature on the demand for labour.\(^6^1\)

Ricardo himself emphasised that he was analysing a relatively restricted case, and warned his readers not to make the inference that machinery should be discouraged. These results applied only to the situation where machinery was suddenly discovered and extensively introduced. Generally, discoveries were more gradual, and, rather than diverting capital from another sector, they encouraged a higher rate of saving.\(^6^2\)

Ricardo’s discovery that technical change could result simultaneously in a rise in net income or total surplus, and in a decline in gross income or total output, did not, however, disturb his general theory of capital accumulation. Prior to this discovery he had analysed the sources of capital accumulation in terms of the distinction between gross and net revenue. He had disputed Smith’s view that the power of any country was to be assessed in proportion to the value of its annual product, because this was the fund from which taxes were ultimately paid. Ricardo separated himself from this view and argued that taxes and savings could only be derived from rent and profits, that is, from net revenue and not from gross revenue. He saw no reason for supporting Smith’s preference for agricultural investment. This preference was based on what Ricardo regarded as the misguided view that agricultural investment created the greatest annual product because it gave motion to the greatest amount of ‘industry’, that is, productive labour. Ricardo added a footnote in the third edition of his Principles denying Say’s charge that he ‘considered as nothing, the happiness of so many human beings’\(^6^3\); in other words, that he ignored the employment-generating characteristics of particular industries.

Ricardo’s discovery was completely compatible with his previous analysis of the mechanisms of accumulation. The rate of accumulation was dependent on net revenue. The capitalist only had an interest in maintaining his rate of profit, and therefore this net revenue. His total product had no bearing on this. However, as Ricardo pointed out, the ‘power of supporting a population’ and the ‘situation of the labouring classes’ depended on total product and not on the surplus,\(^6^4\) and he showed that the condition of the working classes was also dependent on unproductive employment.

Independently of the consideration of the discovery and use of machinery, to which our attention has been just directed, the labouring classes have no small interest in the manner in which the net income of the country is expended ... As the labourers, then, are interested in the demand for labour, they must naturally desire that as much of the revenue as possible should be diverted from expenditure on luxuries, to be expended in the support of menial servants.\(^6^5\)

The chapter on machinery has created major difficulties for historians of economic thought who have wondered about Ricardo’s own assessment of its significance. They have been even more puzzled by its apparent contradiction with the rest of Ricardo’s model. Most historians of thought have seen it as something of a quirk. Pasinetti has argued that the introduction of machinery violated the assumptions of Ricardo’s model: the chapter may perhaps not have been a contradiction but was ‘an honest acknowledgement’ by Ricardo ‘of the limits of his own theory’.\(^6^6\) Blaug argues that Ricardo had hidden motives for not carrying through with the analysis of labour-saving technical change, ‘to have done so would have vitiated the simple model which he had con-

\(^6^1\) Ricardo, Principles, pp. 389–91. See also J. R. Hicks, *A Theory of Economic History*, Oxford, 1969, p. 153; and Hicks, *Capital and Time*, Oxford, 1973; also Hicks, ‘A Reply to Professor Beach’, *Economic Journal*, LXXI, December 1971, p. 925. Ricardo himself clearly explained the dynamic process. ‘I have before observed, too, that the increase of net incomes, estimated in commodities, which is always the consequence of improved machinery, will lead to new savings and accumulations. These savings it must be remembered are annual, and must soon create a fund, much greater than the gross revenue, originally lost by the discovery of the machine’. *Principles*, p. 396.


\(^6^3\) Ibid. p. 349.

\(^6^4\) Ibid. p. 398.

\(^6^5\) Ibid. pp. 392–3.

structured to convey the undesirable consequences of the corn laws'. Finally Hollander argues that Ricardo's failure to examine his model in the light of his new chapter simply reflected his adherence to the methodological position that the realism of the assumptions was of less significance than the predictions derived from them. Hollander has argued more recently that Ricardo's change of position was not really as significant as he had imagined – that the raw materials for the new theory were implicit in the first edition of his work.

All these views of Ricardo simply deny his own perception of the chapter. An analysis of ideas which dismisses the very point a thinker insists he is making is very unsatisfactory history. We can learn more about the significance and implications which Ricardo attached to this chapter if we look at contemporary reactions and his own defences.

The chapter was of obvious importance to the current machinery debates, the debates on technical change and unemployment which pervaded most of this period of the Industrial Revolution. Ricardo himself participated in discussions of Owenism, spade husbandry and the plight of the handloom weavers. I will say more about this below, as the whole issue became very important to subsequent debate. Ricardo's early attitude both to Owen and schemes for the re-employment of the weavers was quite disparaging. He regarded Owen as a visionary as little deserving of attention as Tory fanatics such as Southey. He was scornful of Owen's hopes that community feeling would overcome self-interest.

Ricardo's mind on this issue was not closed, however. He did become involved in a committee of Owenite sympathisers to examine Owen's plans, but Ricardo explicitly separated himself from any commitment to the cause. The most he would concede was what he stated in the House of Commons: 'In a limited degree he thought the scheme likely to succeed, and to produce, where it did succeed, considerable happiness, comfort, and morality, by giving employment and instruction to the lower classes... He could not, however, go along with him [Owen] in the hope of ameliorating the condition of the lower classes to such a degree as he seemed to expect.' He saw himself purely as an economic consultant on the committee. The committee, however, concluded in generally favourable terms to Owen's views, and several critics soon accused Ricardo of complicity in the heresy of Owenism. Trower reported his own amazement at Ricardo's action.

Ricardo attempted to exonerate himself by claiming he was not bound to approve the plans, only to question them: 'Can any reasonable person believe, with Owen, that a society, such as he projects, will flourish and produce more than has ever yet been produced by an equal number of men, if they are to be stimulated to exertion by a regard to the community, instead of by a regard to their private interests? Is not the experience of ages against him?'

Similarly, Ricardo was not at all convinced by the early strategy of the handloom weavers' lobby. John Maxwell presented the motion, which was to recur throughout the 1820s and 1830s, that there be a tax on the power loom to compensate for the tax on workers' consumption goods. Ricardo regarded this as yet another restriction on trade, and argued that it was, rather, the duty of government to provide incentives for the development and not the restriction of industry.

However, Ricardo seems to have expressed less opposition to the Owenite schemes for spade husbandry. He consistently disclaimed any knowledge of agricultural techniques, but saw no reason why the scheme would not work. As he stated in the House of Commons, 'For what did the country want at the present moment? A demand for labour. If the facts stated of spade husbandry were true, it was a beneficial course, as affording that demand.' He separated this scheme from other aspects of Owenism: 'a division of the country into parallelograms, or an establishment of a community of goods, and similar visionary schemes'. Ricardo went so far as to urge that the government circulate 'useful information', and supported the appointment of a committee to look into the matter.

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67 Blaug, Ricardian Economics, p. 71.
70 Ricardo to Trower, 26 January 1818, Letters 1816-1818, p. 247.
71 See the correspondence between Trower and Ricardo: Letters 1819–1821, Trower to Ricardo, 4 July 1819, p. 42, and Ricardo to Trower, 8 July 1819, p. 46.
72 'Meeting on Mr. Owen's Plan', 26 June 1819, Speeches and Evidence, pp. 467–8.
73 Letters 1819–1821, Trower to Ricardo, 8 July 1819, p. 42.
74 Ibid. Ricardo to Trower, 8 July 1819, p. 46.
76 'Sir W. de Cresigny's Motion Respecting Mr. Owen's Plan', 16 December 1819, Speeches and Evidence, pp. 51, 55. Also Ricardo's reaction to Malthus's sarcasm towards spade husbandry, Notes on Malthus, p. 239.
Just as Ricardo, prior to his rethinking of the machinery and labour question, played an active part in contemporary discussions, so he continued to do so after publication of his chapter, and even there he recognised the political implications of his logic and wrote, 'That the opinion entertained by the labouring class, that the employment of machinery is frequently detrimental to their interests, is not founded on prejudice and error, but is conformable to the correct principles of political economy.' Ricardo, moreover, reaffirmed these views in a speech in the House of Commons by criticising a potentially 'useful' popular pamphlet against machine breaking by Cobbett. Here and in his correspondence, Ricardo now dissociated himself from the popular middle-class dogma on machinery. He stood up to McCulloch's wrath that he had given authority to 'all those who raise a yell against the extension of machinery', and that by his word, 'the laws against the Luddites are a disgrace to the Statute Book'. Malthus also objected to the implications of what Ricardo had to say - that his views were 'Liable to be taken fast hold of by the labouring classes'. Ricardo, undaunted, pressed consideration of the question through the Political Economy Club. After two delays it was finally discussed in February 1822. But Ricardo was left disappointed in the reception of his views, 'I could hardly satisfy myself of the general opinion on that disputed point.' Ricardo also continued to stress the importance of his new position, particularly by criticising the popular political economy of his supporters. He drew repeated attention to this in his notes on McCulloch's lecture. At three different points in his criticisms he objected to McCulloch's persistently stated views that the demand for labour was a function of the accumulation of capital and that the interests of masters and workmen were always harmonious. Ricardo placed similar weight on the point in his criticism of James Mill's popular work, Elements of Political Economy.

Ricardo's unequivocal faith in his stand did not, however, encourage him to change his practice and to recommend any change in policy towards machinery. He concluded his chapter by arguing that nothing should be done to discourage technical innovation for fear of capital export. If the use of machinery led to higher returns, capital would flow to the country which encouraged technical change: 'By investing part of a capital in improved machinery, there will be a diminution in the progressive demand for labour; by exporting it to another country, the demand will be wholly annihilated.'

The critical reaction to Ricardo's chapter was primarily a doctrinal and empirical one. Most complained that the case he had set up was a very peculiar one. Few inquired into the analytical implications of the chapter. Malthus was one of these few who complained that he had not 'considered all the bearings of your concession on the other parts of your work'. Ricardo did not take up this challenge. The reasons for this were most likely not those given by Holland, Blaug and Pasinetti. Rather, it would simply not have worried Ricardo that the assumptions of the new chapter did not fit his model, for, as I have shown, this was a highly specific tool set up to show the consequences of hindrances to technical change and foreign trade. The difficulty posed by his new discovery was that it tempered only the positive force of his policy proposals on technical change.

Ricardo's faith in the gains from trade, science, and technology was not left completely unassailed. His chapter on machinery was testimony to that. But few historians have drawn attention to his general optimism otherwise. Even the threat of the stationary state was an unreal one. Not only did the stationary state have no bearing on the immediate future, but the tendency of profits to fall in Ricardo's counterfactual model would be constantly checked in the real world by improvements in

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17 Ricardo, Principles, p. 392.
18 Letters 1819–1821, McCulloch to Ricardo, 5 June 1821, p. 385. McCulloch's anger was justified since Ricardo had only recently criticised him for his view that an increase in the proportion of fixed capital reduced the demand for labour. See Letters 1819–1821, McCulloch to Ricardo, 21 June 1821, p. 393, and Ricardo to McCulloch, 30 June 1821, p. 400. This reason for McCulloch’s anger was also mentioned by Malthus in his letter to Ricardo, Letters 1821–1823, Works, ix, 7 July 1821, p. 9.
19 Letters 1821–1823, Malthus to Ricardo, 16 July 1821, p. 18. Malthus was the first to find out about Ricardo's new views. He at first saw them as supporting his own views on machinery and over-production; see Malthus to Sismondi, Letters 1819–1822, 12 March 1821, p. 377. Ricardo, however, quickly dissociated himself from Malthus's views; see Letters 1819–1821, Ricardo to Malthus, 18 June 1821, p. 387.
20 The question 'Whether machinery has a tendency to diminish the demand for labour' was proposed by Ricardo for discussion on 25 June 1821. This was deferred until the next meeting, then deferred again at this meeting on 3 December 1821. It was finally discussed on 4 February 1822. Political Economy Club Minutes of Proceedings 1821–1823, vol. iv, London, 1822, pp. 43–6; and Ricardo's report on the discussion in his letter to McCulloch, Letters 1821–1823, 18 February 1822, p. 159.
21 Letters 1821–1823, Ricardo to McCulloch, 7 May 1822, p. 194, one of the MS. lectures sent by McCulloch to Ricardo, 17 April 1822.
22 Ricardo, Principles, p. 397.
science and technology. 'Man from youth grows to manhood, then decays and dies; but this is not the progress of nations', for they could 'continue for ages, to sustain undiminished their wealth, and their population'.

The historian need no longer contrast the rapid technical change of the Industrial Revolution with the pessimism and gloom of classical economics. Ricardo's model of distribution and accumulation was an analytical tool moulded to clarify the primary importance of technical change and foreign trade. This purpose becomes obvious once we go beyond the confines of Ricardo's analytical model to what he actually said about the processes and impact of technical change. His purpose was misunderstood by most of his contemporary critics and supporters. But Ricardo none the less dominated early nineteenth-century discussion of the machinery question. His critics based their own contributions on an analysis of technology. They began from a criticism of Ricardo's strict model, yet in so far as they had neglected his wider discussion, they often returned in the end to Ricardo.

Ricardo's novel analysis of the machinery issue provoked not only his critics but his closest followers. The latter were often more interested in the practical implications of the conclusion of his chapter on machinery than they were in the novelty of the theoretical analysis. The chapter on machinery obviously opened deep social concerns among Ricardo's contemporaries. His new ideas rankled, for they sharpened a source of contention already apparent in working-class dissent from industrialisation. Owenism and anti-machinery riots had by now become very real bogies for the optimists of early nineteenth-century industrial capitalism. In the years following Ricardo's death much of the new work in political economy which addressed itself to the future economic prospects of Britain projected a certain polemical tone. It was a polemic incorporated in a purposive inquiry into the universal benefits of industrialisation. Political economists conducted their inquiries into the benefits of industrialisation against the background of both the theoretical heritage of Smith and Ricardo and the practical issues of crisis and depression, Owenite radicalism, and resistance to machinery that flared up in the anti-machinery riots of 1826. It was the response to Ricardo's legacy plus such pressing issues of economic policy which made political economy a discordant though exploratory discipline in the 1820s.

Economists after Ricardo faced many difficulties in coming to terms with his Principles which even in his own time was an intellectual tour de force. Not least among these difficulties was the problem of understanding the status of and the relationship between his twin interests in