

# J. R. McCulloch on the Effect of Machinery\*

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## Abstract:

The differences between the theories of displacement and of compensation of machinery are related not only to issues regarding employment and income distribution but also to the different perspectives on the market economy. Neoclassical as well as contemporary economists criticise Ricardo's machinery theory in the third edition of his *Principles* (1817), which casts serious doubt on the efficiency of a market economy. The compensation theory advocated by economists, such as McCulloch, was in accordance with the neoclassical criticism of Ricardo, wherein they perceive a market economy to be an efficient one. The development of the compensation theory has rarely been studied so far, although its development can be observed in the same way as that of the displacement theory.

This study examines the formation of McCulloch's compensation theory in his debate with Ricardo and its relevance to the neoclassical criticism of Ricardo's machinery theory. McCulloch insisted on the general benefits of machinery from the beginning as stated in 'Taxation and the Corn-Laws' (1820). The basic framework of McCulloch's compensation theory emerged in 'Effects of Machinery and Accumulation' (1821), in which he argued that workers displaced by the introduction of machinery could be employed again owing to the expansion of production, which would be stimulated by the growing demand for commodities caused by the fall in prices. In the correspondence with Ricardo, after the publication of the third edition of Ricardo's *Principles*, McCulloch withdrew his criticism that Ricardo had accepted the possibility of a general glut and focused his criticism on the decrease in gross produce. McCulloch assumes that in arguing this, the maximum amount of a product could necessarily be achieved in the competitive market under a given condition.

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## I Introduction

The effects of machinery on employment have been discussed since the seven-

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teenth century.<sup>1</sup> The machinery question, however, became an important issue in debates around the first half of the nineteenth century. As is well known, the debates on the effect of machinery among classical economists developed substantially because of Ricardo's alteration of his position on machinery in the third edition of his *Principles*. Ricardo argued, after his change in position, that the introduction of machinery would cause the displacement of workers, which would worsen their living conditions. Those who advocated the compensation theory, particularly J. R. McCulloch, were opposed to Ricardo's argument.<sup>2</sup>

Ricardo's machinery theory in chapter 31 of *Principles* has been a controversial issue in the subsequent history of economic thought. Marxists praised Ricardo's argument because they considered it the theoretical foundation of Marx's theory of the relative surplus population. On the other hand, neoclassical economists have criticised Ricardo's proposition for being incompatible with Pareto optimality.<sup>3</sup> They accused Ricardo of arguing that the gross produce would diminish following the introduction of machinery, which means the enhancement of the capacity to supply. Thus, it is indicated that the machinery question could be a 'Rorschach blot'<sup>4</sup> for the author's perception of the operation of market, beyond being related to the effect of machinery on employment. The machinery question has been controversial because it contains the issue of the fundamental hypothesis in economics.

This is the case for the compensation theory as well as the displacement theory of Ricardo's theory on machinery. Ricardo's theory casts doubt on the proposition of market efficiency that the compensation theory supports. J. R.

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1 Groenwegen (1970) and Rashid (2008) briefly introduce discussions on machinery from the seventeenth century to the mid-eighteenth century.

2 O'Brien (1975) and O'Brien (1992) give a detailed description of the economic thoughts of McCulloch. Berg (1980) also refers to McCulloch's thought on machinery in many pages. As Nohara (1984, 19–20) indicates, Malthus, Torrens, Senior and Ellis were also opposed to Ricardo. Malthus however had a different opinion from McCulloch and Torrens on the general glut. In the classical debates of machinery question, the displacement of labour and a general glut (or the role of effective demand) were closely intertwined.

3 See for instance Wicksell ([1934] 2000, 133–44), Jonung (1981) and Morishima (1989, 168–86). Jonung published Wicksell's manuscript once contributed to *Economic Journal* in 1924 that was rejected by Keynes. As for Wicksell's critique of Ricardo, see Negishi (1998) and Gehrke (2011).

4 Samuelson (1989, 48; 56). Samuelson criticises Kaldor (1932) and Stigler (1952) in addition to Wicksell for mistaking Ricardo's argument on machinery as incompatible with Pareto optimality only to interpret it as 'disequilibrium levels of unemployment.' Samuelson praises Ricardo's chapter on machinery for spoiling the false ideology of *laissez faire* (Samuelson 1989, 56), though Samuelson also supposes that Ricardo dealt with technical unemployment only in the short run (*ibid.*, 54). See also Samuelson (1988).

McCulloch set up the compensation theory most comprehensively in the period of classical political economy.<sup>5</sup> However, the perception of market economy behind his theory and his influence on the neoclassical criticism of Ricardo's machinery theory have not been revealed yet.

According to the compensation theory of McCulloch, the increase in real income and the expansion of demand follow the fall in prices that results from the introduction of machinery. Then, McCulloch expresses his views on the operation of market through the law of market.<sup>6</sup> In chapter VII part I of McCulloch's *Principles* (except the first edition), his oppositions are posed to Ricardo's theory on machinery, as well as Sismondi's and Malthus's theory of a general glut through the exposition of the compensation theory.

This paper elucidates McCulloch's arguments and his perception of the operation of market regarding the effects of technical progress. First, the formation of his compensation theory is examined to reveal his fundamental assumptions about a market economy. Then, McCulloch's perception of the operation of a market is considered with his criticism of Malthus, Sismondi, and Ricardo through the examination of McCulloch's arguments in his *Principles*.

This paper is composed of the following arguments. Section II deals with McCulloch's thoughts expressed in 'Taxation and Corn-Laws,' published in 1820, and Ricardo's disagreement with McCulloch in their correspondence. Section III examines McCulloch's arguments in 'Effects of Machinery and Accumulation,' published in 1821, which was alleged to be written in response to Ricardo's opposition. His compensation theory appeared for the first time in the article. Section IV reviews the correspondence between McCulloch and Ricardo in June 1821 after the publication of the third edition of Ricardo's *Principles*. Section V examines McCulloch arguments in his *Principles* to reveal his views on market. The last section concludes by discussing the significance of McCulloch's compensation theory in the context of the history of

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5 The term 'compensation theory' of machinery derives from Marx's usage in *Capital* (Marx 1976, 565). See Hozumi (1958) for the pioneers of the compensation theory.

6 The law of market is now well known as Say's law owing to Marx and Keynes. The origins and meanings of the law is in dispute. Marx refers to Say's 'most celebrated' saying in *Capital* (Marx 1976, 266 n.18) while suggesting that Say owed the idea to James Mill and Physiocrats especially Le Trosne. Blaug asserts that Say's law of market known as 'supply creates of its demand' (Blaug 1978, 160) is Keynes's invention and did not appear in Say's work, which only insisted that a commodity is purchased by another commodity. Keynes describes Say's law as a proposition that aggregated demand price of output is equal to its aggregate supply price, which is equivalent to full employment (Keynes 1936, 26). Blaug also suggests that it was rather McCulloch and James Mill than Say who handed the law of market down to posterity (Blaug 1978, 160).

economic thought.

## II McCulloch's Position on Machinery in the Early Period

McCulloch (1820) appeared as the review article to three works,<sup>7</sup> including Barton (1817). In this article, McCulloch presents his views on the causes of and remedies to the distressed condition of workers at that time. In the first few pages of the article, he criticises the opinion that the distress of the working class stemmed from the harmful effect of the Poor Laws. Although he does not necessarily deny that the Poor Laws would spoil the industry and parsimony of the working class, he tries to illustrate that taxation and the restriction on the corn trade were the main causes of the harsh the burden of distress of the working class at the time (McCulloch 1820, 159).<sup>8</sup>

According to McCulloch, the impact of taxation on necessities, on wages or on profits depends on the condition of the supply of labour. He argues that the taxation on wages and necessities does not always bring about higher wages. If the supply of labour exceeds the demand, workers are in an inferior bargaining position as compared to employers, and the burden of taxation would be imposed on workers. On the contrary, if the supply of labour is repressed by moral restraint or other reasons, employers are forced to raise wages to bear the burden of taxation (McCulloch 1820, 161–62).

McCulloch, however, argues that in both cases, the taxation on necessities or on wages is disadvantageous to workers. The condition of workers is depressed directly by their inferior position, which prevents their wages from being raised following taxation. Their condition becomes worse indirectly through the lag in the accumulation of capital and, therefore, in the fund destined for the maintenance of workers even if wages rise following taxation. He argues that the restriction on the importation of corn has the same effect on the condition of workers as the taxation on necessities and wages. Thus, he insists that the relief of the heavy burden of taxation and the repeal of the Corn Laws are inevitable for the improvement of the condition of workers (McCulloch 1820, 179).

Meanwhile, McCulloch asserts that the condition of workers for about thir-

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7 McCulloch reviews, except for Barton (1817), two works on the Poor Laws and manufacturing system in Great Britain (McCulloch 1820, 155).

8 According to Watarai (2016, 310), McCulloch began correspondences with Ricardo in 1816. But McCulloch already read Ricardo's pamphlets on money, gold and the corn laws before that. The same position on the effects of taxation and the corn laws appeared in his first pamphlet (McCulloch 1816) published during the depression after the Napoleonic Wars.

ty or forty years after the end of eighteenth century had not become as bad as was being expected from the burden of taxation and the Corn Laws. He argues that the first reason for this can be seen in that the introduction of machinery chiefly in the cotton industry, and the consequent lower prices stimulated consumption considerably.

According to McCulloch, 'by those stupendous discoveries which have so much facilitated the great work of production' in the industry, 'the consumption, owing to the fall of prices, was so prodigiously augmented' and 'the progress of this manufacture has been equally rapid.' He continues to argue as follows. 'Here then was an immense field for the profitable employment of capital and industry, created as if by enchantment, and which, more than any other circumstance, enabled this country to sustain the burdens imposed during the late contest, and to bring it to a successful termination' (McCulloch 1820, 168–69).

The second reason, McCulloch argues, was the depreciation of the value of currency at the time, which decreased the outstanding amount of national debt and the burden of taxation in real terms. 'In the second place, the extraordinary depreciation of the currency, during the latter years of the war, must also, by occasioning a proportionable diminution of the public burdens, have powerfully contributed to render us less sensible of the evils attending the constant increase of taxation' (McCulloch 1820, 170).

The third reason that McCulloch cites is the maintenance of soldiers by the government, through which the supply of labour in the labour market decreased, while the animated demand for labour in the cotton industry raised wages. As a result, capitalists incurred the burden of taxation, which was however mitigated by the effects of the introduction of machinery. He argues that 'the capital which comes into the possession of Government, being almost entirely devoted to the support of a numerous body of soldiery, lessens the supply of labour in the market, and consequently raises wages' (McCulloch 1820, 170–72).

Additionally, McCulloch referred to the disruption in the continent by the Napoleonic Wars, because of which the outflow of capital from England was discouraged. Despite these countervailing effects, the condition of the working class had deteriorated through 'the increase of taxation, and the destruction of capital' (McCulloch 1820, 172).

McCulloch points out, while discussing the abovementioned considerations, the relation between the rise in wages and the introduction of machinery, and the effect of machinery on wages and the accumulation of capital.

When the wages of labour continue stationary, it is a matter of comparative indifference to a master manufacturer, or capitalist, whether he employs his surplus revenue in making additions to his circulating capital, or the fund

for paying the Wages of his workmen; or whether he invests it in fixed capital, or Machinery. But, when Wages rise, whether in consequence of a naturally increased demand for labour, or of an increase of taxation affecting necessaries, he will have an instant inducement to employ Machinery in preference to workmen. (McCulloch 1820, 170)

McCulloch believes that the increase in the amount of fixed capital does not serve to form the demand for labour in contrast to circulating capital. Therefore, he mentions that the 'first effect' of making additions to the fixed capital is to sink, rather than increase, the rate of wages, 'since 'the fixed capital invested in a machine, must always displace a considerably greater quantity of circulating capital.' However, he argues that the increase in the circulating capital and the higher wages are achieved as an 'indirect and ultimate consequence of an increase of fixed' capital (McCulloch 1820, 171).

In McCulloch's explanation, the introduction of machinery leads to the expansion of production and benefits all the people through lower prices, while he admits the possibility of a temporal displacement of workers. He asserts that this would resolve the shrinking profits due to higher wages and enhance the accumulation of capital. However, according to him, the introduction of machinery failed to improve the condition of labourers because of the burden of taxation.

Instead of the condition of the labouring classes being improved by the admirable inventions of Watt, Arkwright, and Wedgewood, the increase of taxation, and the destruction of capital, had, long previous to the termination of the war, changed it very much to the worse. (McCulloch 1820, 172)

It is clear from the list of works McCulloch reviews that he referred to Barton's pamphlet to consider the effect of machinery on employment. However, at the same time, McCulloch advocated the general benefits of machinery, which Barton did not assume.

Meanwhile, Ricardo thought that McCulloch expressed doubt about the general benefit of machinery.<sup>9</sup> Ricardo wrote a letter to McCulloch on 29 March 1820 contending that the introduction of machinery would neither diminish the

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9 Whether Ricardo (including after the change of his position) should be considered as advocating the compensation theory or not is still unsettled. Marx did not group Ricardo into the theorists of the compensation theory (Marx 1976, 565). Schumpeter however criticised Marx's account (Schumpeter 1954, 683–84).

demand for labour, nor force wages to fall.

Ricardo argued that even if the introduction of machinery displaces workers and cuts wages down, the lower wages would make the substitution of labour for machinery profitable, which would lead to the recovery of employment and wages. 'If one man erected a steam engine because it was just cheaper to employ the engine than human labour, and if this were followed by a fall in the price of labour, it would be no other man's interest to prefer also the use of the machine' (*Works VIII*, 171).

McCulloch made it clear in his paper published in 1821 that the introduction of machinery never leads to a reduction in employment in response to Ricardo's comments. The next section deals with the paper.

### III The Making of McCulloch's Compensation Theory

At the beginning of the paper, McCulloch explains that the degree of opulence of a society is determined by the production of wealth in the present compared to that in the past. According to him, a society becomes affluent with the reduction in the cost of production of commodities or in the labour required in the production process. Thus, McCulloch defines the objective of political economy as discussing the 'means whereby the greatest possible produce might be rendered obtainable with the least possible expense' (McCulloch 1821, 102). The definition shows the similarity to the neoclassical assumption of the cost minimising decision-making.

Following McCulloch, the improvement in the capacity to supply determines the degree of opulence of a society. With this point of view, he adverts to the notion that the opulence of a society depends on how a society is capable of stimulating consumption rather than its capability of enhancing the capacity to supply. According to him, the insufficient capacity to supply explains the cause of distress of the working class after the Napoleonic Wars.

McCulloch critically examines the notion that the distress resulted from the insufficient expansion of demand for commodities, or the notion that it could not keep pace with the reduction of the cost of production and the growth of production. According to the notion, 'the excess of wealth may be accompanied with all the evils of poverty' because 'the saving of labour in the production of commodities may be carried too far.' In other words, 'a great propensity to save and accumulate capital, or a sudden reduction of taxation, may frequently reduce the population to a state of absolute starvation' (McCulloch 1821, 103). After recounting these notions, McCulloch insists that they are all 'novel and extraordinary conclusions.'

But, whatever truth may be in these novel and extraordinary conclusions, they can derive no support from the distresses in which the productive classes in this country have been involved during the last five or six years.

(McCulloch 1821, 103)

McCulloch himself attributes the distress after the Napoleonic Wars to the sudden loss of commercial monopoly towards the end of the war, to the expansion of national budget during the war, and to the depreciation of the currency since the end of the eighteenth century. Based on these, McCulloch argues that both Sismondi and Malthus<sup>10</sup> cannot find any 'conclusive experience in their favour' (McCulloch 1821, 104). Therefore, McCulloch claims, their opinions must be tested by a careful analysis to ascertain their falsehood.

To refute the theory of a general glut advocated by Sismondi and Malthus, McCulloch criticises 'the objections which have been stated to the continued reduction in the price of commodities caused by the indefinite extension and improvement of machinery' (McCulloch 1821, 104). At this point, the displacement of workers through the introduction of machinery is incorporated with the insufficient demand for goods or the possibilities of general gluts.

McCulloch alleges that workers displaced by the introduction of machinery would immediately be reemployed, through the expansion of production induced by lower prices, in the same industrial branch as they were hitherto employed or in other branches. The framework of his compensation theory of machinery became apparent by this logic.

McCulloch argues that 'an improvement which had the effect of sinking the price of cottons nine-tenths' and 'enabled one-tenth of the capital and labour . . . to produce the same quantity of commodities' could not have 'the effect to throw the other nine-tenths out of employment' since the 'demand for cottons, instead of remaining stationary, would, in such circumstances, be very greatly increased.' Then, he concludes that 'it is certain that the extension of the market, consequent on every new invention to save labour and expense, has always occasioned the employment of an additional number of hands' (McCulloch 1821, 112).

Even if the demand for cotton goods had not increased, the demand for other kinds of commodities would increase. 'The portion of revenue that had been set free by the fall in the price of cottons, would not be permitted to lie

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10 McCulloch criticises Malthus and Sismondi for condemning improvements in production as a great evil, referring to Malthus (1820) and Sismondi (1991). Then McCulloch insists that 'it is plain the existing distress does not afford any solid presumption in favour of the opinions of Messrs. Sismondi and Malthus' (McCulloch 1821, 103–04).



idle. It would unquestionably be applied to purchase an additional quantity of something else. The total effective demand of the society would not, therefore, be in the slightest degree impaired.' The displaced labour from the cotton manufacturers would be reemployed in those branches. 'And after the lapse of such a period as would permit their transfer to these new employments, labour would be again in as great request as ever' (McCulloch 1821, 113).

Most of the contents of the paper are duplicated in chapter VII of part I of his *Principles*. Therefore, this section is confined to the examination of his view on machinery. Particular points are considered in later sections.

McCulloch's view that a community becomes affluent with the improvement of the capacity to supply appeared in McCulloch (1820). In response to Ricardo's comments as seen before, McCulloch strengthened his position by proposing the compensation theory of machinery, which argues that higher real income brought by a reduction in prices through the introduction of machinery never fails to stimulate demand for goods enough to achieve the growth of production and the smooth reemployment of the displaced workers by machinery.

As shall be seen in following sections, McCulloch incorporates the effect of the lower prices on demand for commodities with the law of market already indicated by James Mill and J.-B. Say. Both Torrens (1819) and McCulloch (1821) advocated the law in their argument on machinery, but the former only supposed that a commodity is purchased by another commodity on the condition of the balanced growth of branches producing necessities and luxuries.<sup>11</sup> Therefore, it can be said that McCulloch was the first to comprehensively illustrate the relation between the prices of commodities and demand for them.

Ricardo, however, changed his position on machinery in the third edition of his *Principles*. Ricardo came to argue that when the introduction of machinery gives rise to a decrease in the gross produce, the displacement of workers would be inevitable. McCulloch expressed resentment towards Ricardo's volte-face on machinery, which produced the correspondence between them on the effect of machinery in June 1821. Their exchange of opinions clarified the point of McCulloch's criticism of Ricardo's machinery theory.

#### **IV Correspondence between McCulloch and Ricardo in June 1821**

McCulloch wrote to Ricardo after the publication of the third edition of *Principles* to lodge a protest on Ricardo's thoughts about the effect of machinery. In

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11 On the point, see Shima (1984, 163–64).

the letter to Ricardo on 5 June 1821, McCulloch claims that the differences which existed between Ricardo and both Sismondi and Malthus on the possibility of a general glut have disappeared because of Ricardo's change of opinion on the effect of machinery. In addition, McCulloch accused Ricardo of disgracing political economy as a science. McCulloch remarks that political economy lost its public confidence since the leading figure in this science had easily abandoned his opinion.

I apprehend you will agree with me in thinking that nothing can be more injurious to these interests than to see an Economist of the highest reputation strenuously defending one set of opinions one day, and unconditionally surrendering them the next—The fundamental differences that formerly existed (for I am sorry to think they have now nearly disappeared) between you and Messrs. Malthus and Sismondi induced many to believe that Political Economy was a thing of fudge, a fabric without a foundation.  
(*Works VIII*, 382)

For McCulloch, criticising the position of Sismondi and Malthus played a vital role in asserting the general benefits of the introduction of machinery as seen before. Therefore, McCulloch thought that Ricardo had given way to them to admit the possibility of a general glut when McCulloch saw Ricardo's assertion that the introduction of machinery would harm the interests of workers if it decreases the gross produce and employment. McCulloch addresses Ricardo's numerical example in chapter 31 of *Principles* and says that Ricardo's 'example differs in no respect from that of Sismondi' (*Works VIII*, 383).<sup>12</sup>

In the next instance, McCulloch contends that the decline in prices, and not the gross and net produce, is important for the discussion of the effects of the introduction of machinery. Referring to McCulloch (1821), he argues that it can be proved that the introduction of machinery brings general benefits to the entire community, as long as the decline in prices as a result of the usage of machinery is considered. At the same time, McCulloch stresses that there had never been a decrease in the gross produce as Ricardo mentions. McCulloch asserts

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12 Sismondi expounds that the decline in the cost of production due to the introduction of machinery induces capitalists to use machinery instead of labour. In Sismondi's argument, the substitution of machinery for labour leads to the displacement of workers and the subsequent shrinking of demand for commodities triggers a general glut (Sismondi 1991, 561–62). Sismondi also assumes the fall in price due to the introduction of machinery, but he considered that it is scarcely enough for the expansion of consumption to compensate the displaced employment.

that the introduction of machinery has effectively increased the gross produce through lower prices of commodities.

It is not with greater or less gross or nett produce that we have the smallest concern in considering this question, but simply whether does machinery produce commodities cheaper or not? If it does not produce them cheaper it will not be erected, and if it does produce them cheaper its erection must be profitable to every class of persons—The example which you have given does not, as far as I can perceive, by any means warrant a single one of the extraordinary conclusions you have drawn from it. (*Works VIII*, 383)

Ricardo opposed McCulloch's accusation that the difference between his position and that of Sismondi and Malthus had disappeared, in his letter to McCulloch dated 18 June 1821. Ricardo elucidated his position that the demand for commodities would shrink as gross produce and employment decrease.<sup>13</sup> Ricardo argued that Malthus, on the contrary, claimed that the production of commodities grows in excess of the demand. Ricardo emphasised that the difference between Malthus's position and his position on the possibility of a general glut is clear. Thereafter, Ricardo expounded on his idea that the lower prices of commodities do not generally benefit a community. This is because the reduction in employment as a result of the introduction of machinery decreases the number of people that can purchase commodities (*Works VIII*, 387).

Soon after McCulloch read Ricardo's abovementioned response, he conceded in the letter to Ricardo on 21 June 1821, that Ricardo's position was distinct from Malthus's in that the former deduced the decrease in the gross produce and denied the possibilities of a general glut. 'I beg to apologise for my mistake in saying that you had joined with Malthus' (*Works VIII*, 391).

However, McCulloch then focused his criticism on Ricardo's assumption that the introduction of machinery would decrease the gross produce.<sup>14</sup> 'There would here be a diminution of gross produce, but is it possible that such a diminution could take place without the price of cottons rising? I think it is not. . . . It

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13 Ricardo's arguments in chapter 31 of his *Principles* are not incompatible with the law of market since he assumes that the demand for commodities matches the decreased supply of commodities. Stirati (1994, 186–87) expresses the concept of the equilibrium in classical political economy in that the equilibrium of the produce market does not exclude the unemployment of labour.

14 Ricardo assumes not only the circulating capital but the gross produce as the causes of demand for labour. It remains to be solved which cause Ricardo takes as essential. O'Brien (1992, 304) mentions 'a somewhat strange argument' that 'made employment depend directly upon consumer demand, rather upon circulating capital.'

does not therefore appear to me to be possible to diminish gross produce without raising prices' (*Works* VIII, 391–92). McCulloch supposes, based on the law of market, that the competitive market renders the usage of resources most efficient, which will be confirmed in the next section.

McCulloch, having assumed this proposition, could not accept Ricardo's contention that the demand for commodities would shrink with the decrease in gross produce brought about by the introduction of machinery. McCulloch believes that an artificial decrease in the gross produce should entail a rise in prices, since he assumes that the demand for commodities expands in proportion with the capacity to supply. McCulloch doubted the validity of Ricardo's consideration of machinery as a theory of the competitive market, by considering the numerical example in chapter 31 of Ricardo's *Principles* as a discussion that assumed monopolistic producers.<sup>15</sup>

Having examined and criticised Malthus and Sismondi might have brought McCulloch to consider consumer demand explicitly. McCulloch continued to assume that purchasing power would not be diminished by the introduction of machinery while Ricardo abandoned the assumption in the third edition of his *Principles* with the given amount of capital.<sup>16</sup> McCulloch's approach was reproduced in his *Principles*, to refute Ricardo's contention that the decrease in the gross produce would happen as a result of the introduction of machinery.

## V McCulloch's Criticism of Ricardo in *Principles of Political Economy*

In this section, McCulloch's compensation theory discussed in chapter VII, part I of his *Principles* is examined. The first edition of his *Principles* was published in 1825, based on the articles in the *Supplement of the Encyclopaedia Britannica*, and four subsequent editions were released in his lifetime. From the second to the fourth edition, major revisions were made, but the fifth edition

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15 Blaug (1978, 197) agrees with McCulloch indicating that technical innovation in the production process under the competitive market forces producers to lower prices and expand production.

16 Ricardo illustrates in chapter 31 of *Principles* the displacement of labour by the introduction of machinery with the numerical example where the total amount of capital is unchanged (*Works* I, 388–90). Once considering the accumulation of capital, Ricardo turns to argue that the displacement of labour would not occur as long as the net produce increases enough or more than to remain the gross produce. Ricardo further insists that 'the situation of all classes will be improved' (*Works* I, 392) on this condition. Moroizumi (2008) indicates that one of the main purposes of chapter 31 was to oppose Owen's plan to restrict the introduction of machinery.

was almost the same as the fourth edition except for the chapter on 'Cooperative Associations.' The fourth edition, published in 1849 and which D. P. O'Brien's *Works of J. R. McCulloch* used as copy-text, can be seen as definitive. Therefore, McCulloch ([1849] 1995) is examined in the following.

McCulloch mentions that the effect of the introduction of machinery is essentially the same as the rise in productivity of the craftsman because of improvements in skills and mastery. 'The question respecting the improvement of machinery is, therefore, at the bottom, the same with the question respecting the improvement of the skill and industry of the labourer' (McCulloch [1849] 1995, 197–98). He indicates that if the effect of the introduction of machinery is harmful to a community, one has to conclude that the improvement in skills and mastery could also be harmful to the community. Then he argues that it does not make sense to consider the improvement in skills and mastery as harmful.

Although McCulloch does not entirely deny the possibility that the displacement of workers could occur because of the introduction of machinery, he stresses that the lower prices of commodities further stimulate demand, production, and employment. Thus, he asserts the compensation theory to illustrate that the displaced workers would soon be reemployed with the expansion of production.<sup>17</sup>

In presenting the compensation theory, McCulloch assumes that the demand for daily goods, especially cotton goods, would never fail to expand in proportion to or further than the decrease in these prices. For, according to him, the working class that purchases daily goods constitutes the majority in most communities. 'Those who subsist by their labour, and whose command over necessaries and luxuries is always comparatively limited, form an immense majority of the population of every country' (McCulloch [1849] 1995, 205).

McCulloch argues that the compensation theory is still reasonable, even if it is assumed that the demand for a commodity that is produced by machinery does not expand with the fall in prices. The purchasing power unleashed by lower prices could be used to buy other commodities. The production and employment in those industries would increase, and workers displaced by the introduction of machinery would be reemployed in those industries. It is 'demon-

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17 McCulloch criticises Sismondi's argument with a focus on the effect of machinery before making a refutation of Ricardo. McCulloch first points out that Sismondi does not take into account the employment of labour required to build machinery. Second, McCulloch contends that the excess of revenue after the deduction of profit, which largely consists of the fund for depreciation, is saved to form additional capital (McCulloch [1849] 1995, 207–09). Marx took up the second point favourably (Marx 1971, 68) though he defames McCulloch on many occasions.

strable that there would, under such circumstances, be a corresponding increase in the demand for the products of other employments' (McCulloch [1849] 1995, 206).

Here, McCulloch assumes that the desire of human beings for commodities, except for a few goods including food, is infinite. Therefore, the addition to real income because of lower prices would be used to purchase a variety of commodities (McCulloch [1849] 1995, 206). These arguments were based on the idea of the law of market,<sup>18</sup> which originally states that a commodity is purchased by another commodity.

As is well known, this law denies the possibility of a general glut. McCulloch criticises Malthus and Sismondi's theory of a general glut. McCulloch especially attacks Malthus's idea of insufficient effective demand.<sup>19</sup> McCulloch argues that the demand for commodities or the profitable outlet of investment fund is guaranteed based on the law of market that he assumes by incorporating the effect of lower prices on the demand for commodities.

A fall in the price of commodities affected by the introduction of improved machinery, while it invariably occasions an increase of consumption, occasions also an increase of capital. A diminution in the cost of an article in extensive demand, is really equivalent to an increase in the revenue of all classes, and it is difficult to believe that the means of saving should be increased without a greater accumulation taking place.

(McCulloch [1849] 1995, 209)

In the next place, McCulloch's criticism of Ricardo's machinery theory is examined. It is ascertained that McCulloch accuses Ricardo of omitting the expansion of demand and production because of the lower prices. As mentioned before, Ricardo, in the third edition of his *Principles*, advocated that the introduction of machinery would bring about a decrease in the gross produce and employment (*Works I*, 388).

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18 McCulloch himself appreciates Say for formulating the law of market. 'M. Say was the first who showed, in a full and satisfactory manner, that effective demand depends upon production' (McCulloch [1849] 1995, 217). McCulloch notes the pioneers of the law such as Tucker, Mengotti, and an anonymous author. Lambert ([1952] 2000, 21–22) and Rassekh (2016, 130–31) examine these authors. Lambert also points out that McCulloch's introduction to Tucker and his work is inaccurate (Lambert [1952] 2000, 32).

19 McCulloch also opposes Malthus's idea that a certain form of the fixed capital in a branch of industry cannot be transferred to another branch of industry without considerable loss (Malthus 1820, 404). McCulloch argues that the circulating capital which creates employment can be withdrawn from one branch of industry to another without any loss (McCulloch [1849] 1995, 211–12).

McCulloch first interprets Ricardo's numerical example on the effect of machinery from McCulloch's point of view. Following Ricardo's argument, only a negligible increase in the net produce is enough to encourage capitalists to use machinery. Ricardo's example indicates that the gross produce can be reduced to the amount of profit if the cost of depreciation of a machine is ignorable. 'Mr. Ricardo has supposed that a machine might be introduced, not to reduce the cost of commodities, but that it might yield the same, or, at all events, only a very little more nett profit, than was derived from laying out the capital vested in it on labour' (McCulloch [1849] 1995, 214).

McCulloch illustrates the theoretical consequences by using the example of a capitalist who possesses 10,000 pounds sterling as capital and employs workers to make a profit of 1,000 pounds sterling, now substituting all the workers for machinery. McCulloch argues that following Ricardo, this capitalist would be satisfied with the production of just 1,000 pounds sterling, that is, 'only one-eleventh part of the cloth, or as much as will yield the £1000 of profit' (McCulloch [1849] 1995, 214), ignoring the cost of depreciation.<sup>20</sup>

McCulloch argues, against the considerations that he assumes Ricardo expressed, that the incentive for the introduction of machinery derives from the decline in the cost of production. 'Capitalists resort to machines only when they expect to produce, by their means, the usual supply of commodities with less outlay' (McCulloch [1849] 1995, 214). McCulloch also argues that capitalists encounter difficulty in earning returns on their investment if their product cannot be sold in the market due to a sudden change in trend, for instance.

Therefore, McCulloch suggests that what makes capitalists determine whether to introduce machinery is the expectation that production with machinery will bring more than enough profit to compensate for the risks associated with long-term investment in machinery. 'No man would choose to vest capital in an engine from which it could not be withdrawn, were it only to yield the same, or but a little more profit, than it did when employed in supporting labourers; for this would expose his fortune to very considerable hazard from the caprices of fashion' (McCulloch [1849] 1995, 214–15).

McCulloch contends that 'the greatest improvements, and the utmost facility of production' as a result of the introduction of machinery bring 'the greatest

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20 McCulloch also criticises Barton's numerical example (Barton 1817, 15–16) in Appendix Note B. of the fourth edition of his *Principles*. Here, McCulloch emphasises that Barton did not consider the surplus purchasing power as a result of fall in price, and the cost of depreciation which serves to increase employment. Mazane (1959, 151–55) examines McCulloch's illustration and reveals that it contains double counting of the extra funds for employment.

advantage to all classes.' Then, he concludes that Ricardo's position can be supported neither by experience, nor by reasoning. 'In the actual business of the world, machines never lessen, but always augment *gross produce*' (McCulloch [1849] 1995, 215, italics in original).

In his criticism of Ricardo, McCulloch assumes that the maximum amounts are achieved that can be produced under given conditions of the capacity to supply. The grounds for this reasoning can be found in the proposition that demand expands in response to lower prices and in the disposition of capitalists to reclaim investment funds as early as possible. The assumption seems to be consistent with McCulloch's view on the objective of political economy, that is, to shed light on the means of obtaining the maximum amount of product with the lowest cost of production. McCulloch's criticism of Ricardo clarifies his fundamental understanding of the operation of the competitive market.

## VI Conclusion

Thus far, McCulloch's earlier position on the effect of machinery, the emergence of his compensation theory, and the development of the theory in his *Principles* have been examined. This paper also reveals the fundamental assumptions about the operation of the market economy that underpins his compensation theory of machinery.

McCulloch (1820) identified the foundation on which the Napoleonic Wars could be sustained in England for a prolonged period despite the burden of heavy taxation. According to McCulloch, the fall in the price of cotton goods expanded the demand considerably to create the opportunities for profitable investment. He adverted to the fact that the scarcity of labour due to the use of the workforce as soldiers during the war brought about an upward pressure on wages. However, he continued to argue that the introduction of machinery and the displacement of workers mitigated the upward pressure on wages and facilitated the accumulation of capital.

McCulloch's comments on the effect of machinery draw from Barton's pamphlet published in 1817. However, McCulloch had the notion that the introduction of machinery would generally benefit all the people in a community through the encouragement of the accumulation of capital, which Barton did not account for. McCulloch maintained the position for the rest of his life that the introduction of machinery benefited all the people of a community. It can be said that this position formed the ideological ground for McCulloch's compensation theory.

Nevertheless, McCulloch's argument on the displacement of workers by machinery encountered criticism in Ricardo's letter to him dated 29 March



1820. In McCulloch (1821), he presented the compensation theory of machinery and responded to Ricardo's criticism that the displacement of workers would occur only temporarily, and therefore the displaced workers would soon be reemployed.

McCulloch's argument is critical of Malthus and Sismondi, as he assumed that the demand for commodities increases proportionately with the capacity to supply. Thus emerged McCulloch's compensation theory that the lower prices of commodities, which the introduction of machinery brings, never fail to increase the demand for commodities and encourage the expansion of production and employment. McCulloch incorporated the effect of lower prices on the demand for commodities with the law of market ahead of other authors of the classical political economy. McCulloch developed his compensation theory comprehensively through the perception above.

Shortly after the publication of McCulloch (1821), Ricardo allegedly made a shift to his renewed position on machinery in the third edition of *Principles*. There, he argued that the introduction of machinery would be injurious to the interest of workers when it reduces the gross produce, therefore employment, and leads to a decrease in wages.

McCulloch protested Ricardo and focused his criticism on the argument of decrease in the gross produce, by arguing that Ricardo's argument is valid in a monopolistic economy. Then, McCulloch stresses that the maximum amount of product under a given condition of production is achieved in the competitive market. In chapter VII Part I of his *Principles*, McCulloch argued that Ricardo's position could be supported neither by reasoning of political economy, nor by experience thus far. Finally, McCulloch's compensation theory had brought its completion.

In ascertaining the development of compensation theory, McCulloch's view was revealed that the most effective allocation of resources is achieved in a competitive market, such that the maximum amount of goods could be obtained with the minimum production cost. The assumption shows a strong similarity to that of the neoclassical school,<sup>21</sup> albeit unintentionally. This paper reveals that the compensation theory of McCulloch affected the neoclassical criticism of Ricardo's machinery theory, such as Wicksell's. McCulloch's compensa-

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21 The definition of 'neoclassical' has been in question on many occasions. As Morgan (2016) indicates, the definition varies depending on the contexts. Some uses it as a synonym of mainstream or orthodoxy and others uses it as a part of mainstream. The definition in terms of political economy also prevails, which consists of (1) methodological individualism, (2) methodological instrumentalism, and (3) strong orientation to equilibrium. Morgan also stresses the ideological aspect of 'neoclassical' in the third definition (Morgan 2016, 6).

tion theory might anticipate the neoclassical theory regarding the effect of technical progress.<sup>22</sup>

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22 What follows might also suggest McCulloch's closeness to the neoclassical proposition. McCulloch came to accept Say after Ricardo passed away, regarding the theory of value, productive and unproductive labour in addition to the law of market. It is also desirable to consider the theoretical and methodological connection between McCulloch and Say. On this point, see Kubo (2014).

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