TECHNOLOGICAL UNEMPLOYMENT. A BRIEF HISTORY OF AN IDEA

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ABSTRACT

This article traces a brief history of a particularly relevant concept in political economy and economic sociology: technological unemployment. The historical narration aims at covering four centuries, since the beginning of the industrial revolution up to the present. As a consequence, it has to be highly selective. It is mainly based on sources in the English language and refers only to a few of the many social scientists involved in the debate. The scopes of the inquiry are essentially two. The first is to show that focusing on technological unemployment as an idea – and not simply as a phenomenon – is appropriate, because of the high level of controversy that still characterizes the debate. The second is to drive attention to a concept that could be extremely useful to understand the technological and societal changes occurring in the twenty-first century.[11]

1. GENERALITIES

The concept of technological unemployment is regaining momentum in the discourse of economists and economic sociologists. However, when analyzing the debate, what is most surprising is the substantial absence of agreement on the very existence of technological unemployment as a phenomenon. Some observers present technological unemployment as a sprawling monster that is completely subverting the global economy, while others conclude that this picture is just a mirage of doomsayers. Since reputable scholars are engaged in the debate, we cannot simply blame the polarization of narratives on the incompetence of one or the other school of thought. Even if the definitions of technological unemployment provided by different sources do not differ particularly, it has become evident that the terms contained in these definitions may assume different meanings depend-

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ing on the theoretical perspective.

Unemployment is a phenomenon studied by both sociologists and economists. As Tony Elger (2006: 643) remarks, "[s]ociologists often focus on the experience and consequences of unemployment, leaving economists to analyze causes. […] However, consideration of the underlying processes that generate these patterns of unemployment exposes continuing controversy among economists, for example between neoliberal, neo-Keynesian, and neo-Marxist analyses of the political economy of contemporary capitalism. Thus, economic sociologists have to adjudicate between these different causal accounts [...]"

Unemployment is a complex phenomenon. "Economists distinguish between frictional unemployment, involving individual mobility of workers between jobs; structural unemployment, resulting from the decline of particular sectors or occupations; and cyclical unemployment, resulting from general but temporary falls in economic activity" (ibid.). To this list, one can add technological unemployment.

The Oxford Dictionary of Economics defines technological unemployment as follows: "Unemployment due to technical progress. This applies to particular types of workers whose skill is made redundant because of changes in methods of production, usually by substituting machines for their services. Technical progress does not necessarily lead to a rise in overall unemployment" (Black 2012: 405). As one can see, it is a concept that already includes a theory, since it puts into causal relationship two distinct phenomena: technological progress and unemployment. The disagreement between the different schools of thought mainly concerns the existence of this causal relationship.

Technological unemployment can be studied at different levels of the economic system: at the level of individual actors, companies, productive sectors, countries, or global economy. That at least *one individual* has lost his job because the employer or the customer has purchased a machine that can accurately perform his/her duties is a fact that can hardly be denied. Similarly, it cannot be denied that entire companies have been automated and this process has resulted in a drastic reduction of employment *inside the company*. As well as it cannot be denied that, owing to technological innovation, *entire economic sectors* have been largely emptied of their workforce. The transition from traditional agriculture to intensive agriculture, through the use of agricultural machinery, herbicides, fertilizers, fungicides, etc., has led to demographic emptying of the countryside. The evaporation of jobs in the primary sector of the United States of America offers impressive numbers: in 1900 41% of the population was employed in agriculture, a century later, in 2000, only 2% of Americans still worked in same sector (Wladawsky-Berger 2015). A similar phenomenon was observed in the sec-

ondary sector, or manufacturing, at the turn of the twentieth and twenty-first century. In the United States, the ratio between employment in the factories decreased from 22.5% in 1980 to 10% today and is expected further decline to below 3% by 2030 (Carboni 2015). Similar situations can be observed in other industrialized countries, including Italy (Campa 2014a).

This emptying of whole sectors of the economy was accompanied by a *migration* of the workforce from one sector to another. A first migration was observed from agriculture to manufacturing, a visible phenomenon because it also led to a massive migration from rural to urban areas. A second migration of the labor force, less visible but equally significant, occurred from the manufacturing sector to the services sector (Campa 2007). Overall, at least so far, the increase in productivity in individual sectors has not resulted in the emergence of a permanent and chronic technological unemployment on a global level. This does not mean, however, that technological unemployment – at least as a temporary or local phenomenon – does not exist.

It should also be clear that the reabsorption of the unemployed into the economy has been possible thanks to two main levers: the first is *free market*, which enabled the birth and development of new sectors of the economy; the second is social and industrial *public policies*. The fact that both forces are at work is often obscured by the fact that observers are largely divided into two tribes: those who worship the Market as an almighty God, and those who attribute an analogous divine character to the State. Only those who do not profess either 'religion' can see that many factors have contributed to dampen the phenomenon of technological unemployment. Private entrepreneurs have created manufacturing industries and used the cheap labor flowing from countryside to city, in the nineteenth and early twentieth century. New enterprising capitalists have created service companies to redeploy manpower pouring out from factories, in the second half of the twentieth century. At the same time, trade unions and socialist political parties, through tough political and labor struggles, have succeeded in achieving steady reduction of working hours (even a halving of working hours, if we consider the period from the nineteenth century to the present), retirement and disability pensions, paid holidays, paid sickness, maternity leave, and other social rights, which on the whole have forced private employers to hire more workers than they would have hired in a laissez-faire capitalist regime.

Moreover, the idea that the equilibrium of a national economy is assured by the Invisible Hand is belied by the fact that employment crises have sometimes been resolved by the mass migration of workers from one country to another. This means that it is not written in the stars that capable private entrepreneurs and creative people who create new jobs, new companies, or even new economic sectors must continually rise. If they do not rise, if there

are no social and cultural conditions that permit them to arise, the unemployment crisis generated by the introduction of new technologies can become chronic and irreversible in a specific geographical area. Finally, other forms of public intervention, such as industrial policies, have contributed to cushion the phenomenon. For instance, the creation of public manufactories, the nationalization of private companies, public contracts (just think of the incidence of military spending in the United States), wars, crime (the prison population in the US now exceeds two million individuals), as well as the creation of millions of jobs in the public service – jobs that are sometimes unnecessary and therefore constitute a permanent masked dole.

If you consider all these aspects, some of which are ignored by economic theory, it seems difficult to deny the existence of technological unemployment. Somewhat different is the question of whether it is a significant phenomenon on a global scale. From the psychological point of view, being replaced by a machine is certainly a big concern for those who lose their jobs, even temporarily. But the issue begins to acquire political relevance only if the proportion of individuals affected by the phenomenon is likely to disrupt an entire economic system. Throughout history, different moments when the phenomenon of technological unemployment has assumed critical proportions were observed. In these periods, the idea of technological unemployment has gained major relevance in the public debate.

2. LUDDISM: THE FIRST REACTION

Notoriously, a rather critical moment in European history was the transition from feudalism to capitalism, and not only for bloody political revolutions that accompanied the transformation. In the so-called feudal system, the creation of work did not constitute *a problem*, because social mobility was minimal. Children inherited the job of their fathers. The children of the farmers knew that they would be farmers themselves, or serfs. The children of the artisans learned their profession in the workshops of their fathers. The eldest son of an aristocratic family inherited the family estate, while his younger brothers were initiated in a military or ecclesiastical career. Daughters would be wives of men chosen by the father, or nuns. Beggars, robbers, vagabonds, prostitutes, and adventurers formed exceptions to the strict rule. In the Middle Ages, others were the economic concerns: wars, epidemics, famines. A serious problem that could arise was rather labor shortages as a result of these phenomena.

With the transition to capitalism, previously unknown problems arise: in particular, overproduction and unemployment. The introduction of machines in the production system and social mobility disrupt the traditional concep-

tion of work and life. To many, it appears inconceivable that someone willing to work cannot find a job. So much so that the first reaction of the political authorities is to limit the use of the machines where cause unemployment. Even mercantilist Jean-Baptiste Colbert, who gave great impulse to the industrialization of France by the creation of so-called *Manufactures nationales*, passed measures to restrict the use of machines in private companies.

Where the authorities do not intervene, the workers themselves may make a fierce and desperate struggle against the machine, of which we find a detailed account in *Capital* by Karl Marx (1976: 554-555): "In the seventeenth century nearly all Europe experienced workers' revolts against the ribbon-loom, a machine for weaving ribbons and lace trimmings called in Germany *Bandmühle*, *Schnurmühle*, or *Mühlenstuhl*. In the 1630s, a wind-driven sawmill, erected near London by a Dutchman, succumbed to the rage of the mob. Even as late as the beginning of the eighteenth century, saw-mills driven by water overcame the opposition of the people only with great difficulty, supported as this opposition was by Parliament. No sooner had Everett constructed the first woolshearing machine to be driven by water-power (1758) than it was set on fire by 100,000 people who had been thrown out of work. Fifty thousand workers, who had previously lived by carding wool, petitioned Parliament against Arkwright's scribbling mills and carding engines. The large-scale destruction of machinery which occurred in the English manufacturing districts during the first fifteen years of the nineteenth century, largely as a result of the employment of the power-loom; and known as the Luddite movement, gave the anti-Jacobin government, composed of such people as Sidmouth and Castlereagh, a pretext for the most violent and reactionary measures. It took both time and experience before the workers learnt to distinguish between machinery and its employment by capital, and therefore to transfer their attacks from the material instruments of production to the form of society which utilizes those instruments."

David F. Noble (1995: 3-23) maintains that the Luddites are not to be considered technophobic. When the machinery was introduced in manufactures, the workers destroyed it because of necessity, not because of technophobia. Their choice was limited to three options: 1) starvation for them and their families; 2) violence against the uncompassionate owners of the means of production; 3) destruction of the means of production. Choosing the third option was the mildest way to communicate their discomfort as regards unemployment.

The reaction of the political authorities was clearly less mild. Such was the incidence of the phenomenon that the English government implemented the death penalty for Luddites. The 'assassination' of a machine was put on a par with the assassination of a human being.

3. Classical Political Economy: The First Denial

In spite of the fact that the appearance of machinery produces worrisome social disorders, economists are reluctant to modify their theories in order to make place for technological unemployment. There are just a few exceptions. For instance, an attempt at conceptualization is found in James Steuart's book *An Inquiry into the Principles of Political Economy* (1767), and precisely in chapter XIX ("Is the Introduction of Machines into Manufactures prejudicial to the Interest of a State, or hurtful to Population?"). Steuart admits that the sudden mechanization of a segment of the production can produce temporary unemployment and, therefore, public policies are needed to facilitate the absorption of the labor force into other tasks. He is still persuaded that the advantages of mechanization outweigh negative side effects, but is also convinced that problems do not solve themselves. However, that of Steuart is an isolated voice.

Classical economics is dominated by Adam Smith's optimistic perspective, which emphasizes the positive effects of mechanization and the self-regulating nature of market economies. In his masterpiece *An Inquiry into the Nature and Causes of the Wealth of Nations*, he provides evidence of a causal connection between high taxation and unemployment (Smith 1998: 1104), or excessive prodigality of the landlords and unemployment (Smith 1998: 448-449), rather than between the use of machinery and unemployment. Machinery is mainly seen as a means to increase the productivity of laborers: "The annual produce of the land and labour of any nation can be increased in its value by no other means but by increasing either the number of its productive labourers, or the productive powers of those labourers who had before been employed. […] The productive powers of the same number of labourers cannot be increased, but in consequence either of some addition and improvement to those machines and instruments which facilitate and abridge labour; or of a more proper division and distribution of employment" (Smith 1998: 455-456).

When Smith takes into consideration the possibility of a connection between the mechanization of labor and the redundancy of laborers, he sees this situation uniquely as a chance for capitalists and landlords, and not as a problem for the working class: "In consequence of better machinery, of greater dexterity, and of a more proper division and distribution of work, all of which are the natural effects of improvement, a much smaller quantity of labour becomes requisite for executing any particular piece of work, and though, in consequence of the flourishing circumstances of the society, the real price of labour should rise very considerably, yet the great diminution of the quantity will generally much more than compensate the greatest rise which can happen in the price" (Smith 1998: 338).

Afterwards, classical economists developed "the theory that the working class is being compensated for initial sufferings, incident to the introduction of a labor-saving machine, by favorable ulterior effects" (Schumpeter 2006: 652).

Marx baptizes this theory as *theory of compensation*. Among the fathers of the theory, Marx lists James Mill, John McCulloch, Robert Torrens, Nassau W. Senior, and John Stuart Mill. David Ricardo should also be added to the list. In synthesis, this theory states that, if new machines allow to save labor, manpower will be needed for the production of said machinery. Also, if initially the new production processes saves labor, then they boost demand and jobs, through the reduction of costs and, therefore, the price of the goods offered. Finally, it is hypothesized that there is a perfect identity between income and spending, and therefore the theory assumes that the major revenues arising from the reduction of the workforce in factories and farms will result in greater demand for consumer goods by capitalists and landlords, which in turn will create new jobs.

4. The Conversion of David Ricardo

If this is so, why do laid-off workers get so angry? Evidently, even admitting that there is a medium-term or long-term compensation of losses, the short-term effects are devastating for a social class that has no capital or assets. For those who live for the day, and perhaps have many children to support, even a few weeks unemployment can be lethal. If we consider that, in order to find a new job, the proletarian must sometimes emigrate, leaving loved places and people, or accept a less satisfying and less remunerated job, while he or she sees his or her former employer getting richer thanks to the new machinery, his or her backlash appears less mysterious.

It is for this reason that the great economist David Ricardo, in 1821, decided to bring the issue of technological unemployment into economic theory. It must be said that, initially, Ricardo not only remained in the wake of classical economics, denying the issue and arguing that the introduction of machinery is beneficial to all social classes, but had also produced what Blaug (1958: 66) has called "the first satisfactory statement of the theory of 'automatic compensation'." Subsequently, however, disorienting his own followers, "Ricardo retracted his former opinion on the subject" (Kurz 1984). In the third edition of Ricardo's *Principles of Political Economy and Taxation*, published in 1821 – and precisely in Chapter XXXI, "On Machinery" – one can indeed find both the admission of the conversion and a clear formulation of the idea of technological unemployment.

Ricardo (1821: 282) states that it is more incumbent on him to declare his

opinions on this question because they have, on further reflection, undergone a considerable change: "Ever since I first turned my attention to questions of political economy, I have been of opinion, that such an application of machinery to any branch of production, as should have the effect of saving labour, was a general good, accompanied only with that portion of inconvenience which in most cases attends the removal of capital and labour from one employment to another."

The English economist proceeds by summarizing the theory of compensation. Afterwards, he states that these "were" his opinions on the matter. More precisely, Ricardo (1821: 283) states that his opinions "continue unaltered, as far as regards the landlord and the capitalist;" but now he is convinced "that the substitution of machinery for human labour, is often very injurious to the interests of the class of labourers."

That this injury concerns both salaries and employment chances is declared a few pages later. First, he provides examples based on numbers. Then, he concludes as follows: "All I wish to prove, is, that the discovery and use of machinery may be attended with a diminution of gross produce; and whenever that is the case, it will be injurious to the labouring class, as some of their number will be thrown out of employment, and population will become redundant, compared with the funds which are to employ it" (Ricardo 1821: 286). Historians of economics often underline the importance of this step. For instance, Heinz D. Kurz (1984) concludes that, thanks to Ricardo, the idea of technological unemployment "marks its first appearance in respectable economic literature."

As we have seen, the Luddites had denounced this problem much earlier, but not until Ricardian economic theory did technological unemployment take on the aura of a scientific concept. After Ricardo, classical economists were obliged to refute the most simplistic forms of compensation theory and to develop more sophisticated forms of it.

In his 1848 *Principles of Political Economy*, John Stuart Mill (2009: 51) states that "[a]ll attempts to make out that the laboring-classes as a collective body *can not* suffer temporarily by the introduction of machinery, or by the sinking of capital in permanent improvements, are, I conceive, necessarily fallacious." He stresses that it is "obvious to common sense" and also "generally admitted" that workers would suffer in the particular department of industry to which the change applies. However, he still concludes that, at least in opulent countries, the extension of machinery is not detrimental but beneficial to laborers. In his words, "the conversion of circulating capital into fixed, whether by railways, or manufactories, or ships, or machinery, or canals, or mines, or works of drainage and irrigation, is not likely, in any rich country, to diminish the gross produce or the amount of employment for labor" (Stuart Mill 2009: 252).

5. KARL MARX: BEYOND THE ECONOMIC THEORY

The subtitle of Karl Marx's *Capital* is *A Critique of Political Economy.* As a consequence, to label "political economy" his own scientific work would imply some degree of intellectual violence. It is also true that no discipline can easily describe his theoretical and empirical contributions to social science. Besides being considered a philosopher, a political thinker, an historian and an economist, Marx has been also described as a sociologist (Lefebvre 1982, Durand 1995) and, more specifically, as an *economic sociologist* (Swedberg 1987: 22-24). This characterization is particularly appropriate when talking about technological unemployment.

Economic sociology and political economy are two mutually enriching disciplines, differing in a few important respects (Smelser 1976). One of these is the range of the analysis. The former offers a holistic point of view, by paying attention also to cultural determinants, emotional dimensions, and social consequences of economic phenomena. Economists asks themselves if there is a causal connection between technological development and unemployment, in the short or the long run. Economic sociologists aim also at knowing the life conditions of workers inside and outside the factory, that is: if they work safely or unsafely, if they are mobbed when employed, if they abuse alcohol or fall into depression when unemployed, how and where their family live, how many children they have, if their children go to school, if they were forced to migrate, etc.

When we read the chapter on "Machinery and Large-Scale Industry" of *Capital*, we find much information that we can hardly find in a book of political economy. Here is just an example: "Here we shall merely allude to the material conditions under which factory labour is performed. Every sense organ is injured by the artificially high temperatures, by the dust-laden atmosphere, by the deafening noise, not to mention the danger to life and limb among machines which are so closely crowded together, a danger which, with the regularity of the seasons, produces its list of those killed and wounded in the industrial battle" (Marx 1976: 552).

Unlike the economist of his time, who would just deal with laws and regulations by assuming that they are respected and, therefore, constitute a solid basis for predictive theories, Marx takes into account also the possibility that laws and regulations may remain just on paper and never affect real factory life. This is the typical sociological point of view. For instance, Marx (1976: 552) notes that "although it is strictly forbidden in many, nay in most factories, that machinery should be cleaned while in motion, it is nevertheless the constant practice in most, if not in all, that the workpeople do, unreproved, pick out waste, wipe rollers and wheels, etc., while their frames are in motion. Thus from this cause only, 906 accidents have occurred during the six

months…"

Coming to the problem of unemployment, Marx observes that machinery has not freed man from work and guaranteed widespread well-being as the utopians promised. It has rather caused the loss of any source of income for part of the working class and the inhuman exploitation of those who remained employed in the factory. This is because, by simplifying and easing the physical work, machinery allowed physically stronger adult males to be replaced by women and children. The benefit to the owners of the means of production was threefold: less labor required; lower cost of labor because women and children were considered lower rank workers; and indefinite time extension of work, because the natural physical fatigue of workers was no longer an obstacle to it. The result was the unemployment and brutishness of adult males, who remained at home to laze around or get drunk, while their relatives were buried alive in the factories.

Not without sarcasm, Marx (1976: 557) notes that "[i]t is supposed to be a great consolation to the pauperized workers that, firstly, their sufferings are only temporary ('a temporary inconvenience') and, secondly, machinery only gradually seizes control of the whole of a given field of production, so that the extent and the intensity of its destructive effect is diminished. The first consolation cancels out the second."

No wonder then that Marx (1976: 565) praises Ricardo for his "scientific impartiality and love of truth." Similarly, Lowe (1954: 142) will characterize the chapter "On Machinery" by Ricardo as "a rare case of self-destructive intellectual honesty." The debate on the scientific legitimacy of the concept, however, did not end after Ricardo and Marx.

6. THE MARGINALISTS: MATHEMATICS *VERSUS* LUDDITE FALLACY

The birth of neoclassical (or marginalist) economic theory changes the cards on the table. In particular, after the works of Swedish economist Knut Wicksell the concept of technological unemployment enters a crisis and the balance begins to lean again in favor of compensation theory. Wicksell bases his analysis on the law of marginal productivity of factors of production and claims that wages are the key to the problem. According to his theory, there is no direct causal relationship between technological progress and unemployment, because there is another ultimate cause of unemployment. While the expulsion of workers for the implementation of technical innovations creates an increase in labor supply over demand, it is also true that in a free economy the increase in supply leads to a decrease in wages. In turn, the reduction of the remuneration of labor in comparison to that of capital stimulates the demand for labor, for the sectors not yet affected by technological

innovation will find it convenient to absorb the excess labor. In other words, the unemployment rate that remains stable in the medium or long term – the one that really worries people and governments – is not attributable to the increase in productivity caused by technological progress, but eventually to the rigidity of a wage bottom which prevents the reabsorption of workers in less advanced sectors.

Compared to classical economists, the representatives of the marginalist school adopt more sophisticated mathematical tools, such as infinitesimal calculus, and, thanks to the greater professionalization, the concept of marginal utility – which is the basis of their theory – can be accurately and formally defined.

Wicksell was originally a mathematician, and only afterwards entered the field of economics. This is the way he dealt with the problem: "If x and y are the number of labourers per acre on the first and second methods of cultivation respectively, and the productivity function in the one case is $f(x)$ and in the other $ø(y)$; and if we assume that m acres are cultivated on the first method and n acres on the second, then we must look for the conditions under which the expression

$$mf(x) + nø(y)$$

reaches its maximum value if, at the same time,

$$m + n = B$$

and

$$mx + ny = A$$

where B is the number of acres and A the number of labourers available for the industry in question (here agriculture) as a whole. By differentiation and elimination (the partial derivatives of the first expression being put = 0) we can easily obtain the two equations

$$f'(x) = ø'(y)$$

and

$$f(x) - xf'(x) = ø(y) - yø'(y),$$

of which the former indicates that when the gross product is a maximum the marginal productivity of labour, and therefore wages, will be the same in both types of production, The second equation gives the same condition for rent per acre.

Thus, although at first sight the going-over of some firms to the new method of cultivation seems to diminish the total product, actually the total product is maximized; *but at the same time wages necessarily fall*, so long as we assume that the gross product is less in the estates cultivated by the new method than in those cultivated by the old" (Wicksell 1977: 140).

The idea that the whole debate among theorists of technological unemployment and theorists of automatic compensation could develop only because of the lack of professionalization of nineteenth century economists becomes widely accepted in academia. For instance, Schumpeter (2006: 652) concludes that "[t]he controversy that went on throughout the nineteenth century and beyond, mainly in the form of argument pro and con 'compensation,' is dead and buried: as stated above, it vanished from the scene as a better technique filtered into general use which left nothing to disagree about."

To be precise, the controversy was "dead and buried" only for the economists of the neoclassical school (Montani 1975). For non-orthodox economists, in the folds of the calculations, a bleak thesis (to say the least) was hidden: if the Luddites attributed the 'fault' of unemployment to machinery, and Marxists to the capitalist system of exploitation, neoclassical economists unloaded it on workers who were not satisfied to work for a mess of pottage, or on those social democratic governments that imposed a minimum hourly wage so that workers could at least survive.

7. The Keynesians: Technological Unemployment as Fact

The hegemony of neoclassical economics in academia seemed to be unassailable, when a game changer enters the spotlight: the devastating economic crisis of 1929. A new paradigm, the Keynesian, becomes destined to take stake in political and scientific circles. Challenging the orthodoxy, in a 1930 article published in *The Nation*, John Maynard Keynes reintroduces the concept of technological unemployment in the economic discourse. Quite curiously, he speaks about it as *a new disease*, as if Ricardo and Marx had never discussed the issue before. These are his words: "We are being afflicted with a new disease of which some readers may not yet have heard the name, but of which they will hear a great deal in the years to come – namely, *technological unemployment.* This means unemployment due to our discovery of means of economising the use of labour outrunning the pace at which we can find new uses for labour. But this is only a temporary phase of maladjustment. All this means in the long run *that mankind is solving its economic problem*" (Keynes 1963: 325).

Keynes is not a pessimist, nor a Luddite. He sees in technological progress a great resource for humanity. He is convinced that technological unemployment is only a temporary illness. This is because he is confident in the possibility of solving the problem with appropriate public policies, starting with a drastic reduction of working hours. In the same article, the English economist forecasts that "in the course of our life" (that is, in the space of a few decades), we will see ongoing social reforms that will lead us to

work three hours a day, five days a week, for a total of fifteen hours per week, at equal income conditions. In short, it seemed reasonable to solve the economic crisis by implementing a simple formula: working less, work for all. That is, by evenly redistributing the benefits of technological progress.

During the Great Depression, other outstanding scholars focus on the problem of technological unemployment. In August 1930s, Paul H. Douglas publishes an article entitled "Technological Unemployment" in the *American Federationist*, but only to say that the introduction of labor-saving improvements cannot cause permanent unemployment. He maintains that we should rather expect an "automatic" absorption into employment of fired workers, because the demand of employers and those workers still employed is destined to grow as a result of the reduction of costs per unit of output due to technological improvement.

One year later, Alvin Hansen responds to Douglas with an article entitled "Institutional Frictions and Technological Unemployment", appearing in *The Quarterly Journal of Economics* (1931). Here, Hansen accuses Douglas of reviving the old doctrine of J. B. Say, James Mill, and David Ricardo (meaning the first and second editions of the *Principles*), and in particular the grave fallacy of compensation theory.

Quite significantly, Hansen was still not "the American Keynes" in the moment when he published this article. He still defended the orthodox theory in 1937, when he occupied the chair of Political Economy at Harvard University. His conversion to Keynesianism happened later, but here we can see that there was already a convergence on the issue of technological unemployment.

The 1930s polemics does not end here. Gottfried Haberler (1932: 558) immediately takes the defense of Professor Douglas, "for it would be deplorable if an ungrounded hostility and suspicion against technological progress should be aroused or intensified."

That 'temporary' technological unemployment exists seems not in doubt even among defenders of the orthodox theory. The question is if 'permanent' technological unemployment does exist. Ten years later, Hans P. Neisser upgrades technological unemployment from concept to theory. Indeed, these two words express a causal relation, and therefore a law. More precisely, Neisser (1942: 50) laments that "the theory of technological unemployment is a stepchild of economic science." We read the following lines and we understand that, for this scholar, there is perfect adherence between this neglected theory and 'facts'. Permanent technological unemployment is not only a useful theoretical concept. It is a real phenomenon. Thirteen years after the 1929 crisis, in spite of compensation theory, there are still masses of involuntary unemployed workers: "The facts seem to stand in such blatant contradiction to orthodox doctrine, according to which no 'permanent' tech-

nological unemployment is possible, that most American textbooks prefer not to mention the problem itself" (ibid.).

What is more important is that this 'silence' is unprecedented. Neisser reminds the readers also that "[t]he analysis to which Ricardo subjected the displacement of labor by the machine in the last edition of the *Principles* had stimulated a lively discussion among the later classical economists…" (ibid.). The discussion died down because of the rise of neoclassical equilibrium analysis. However, Neisser correctly underlines that this 'silence' concerns only "Anglo-Saxon literature."

Everett Hagen (1942: 553) also remarks that only "[t]wo papers in American economic journals of the past eleven years have address themselves exclusively to the correction of errors in the prevailing analysis of technological unemployment." He means that written by Hansen in 1931 and that published by Neisser in 1942. He recognizes that Naisser makes a "definite contribution," but he also reproaches him for having completely ignored Hansen and for having written an article in the "post-Keynesian period" that fails "to apply to the problem at hand the theory of saving and investment as determinants of employment." Hagen gives himself the task of filling the hole.

Indeed, the debate is much richer than it seems. First of all, it takes place also in books and not only in articles published in economic journals. An example is the book *Value and Capital* by John R. Hicks. The first edition appears in 1939. The second edition is published in 1946 and, afterwards, is reprinted many times. Here the term 'technological unemployment' appears only at page 291, but the concept to which the term refers is discussed also in other parts of the book. The author stresses the fact that technology may produce unemployment only in specific situations, for instance, "that in which the new equipment, which has been produced, is 'labour-saving'; in this case there is a fall in the demand for labour, as a result of the whole process, relatively to the situation which would have arisen if no capital had been accumulated at all." In other words, "there is not necessarily a fall in the demand for labour at all; there will be if early inputs and late inputs of labour are substitutes, but not if they are complementary" (Hicks 1946: 291).

Another book assessing the problem very seriously is *The Path of Economic Growth*, published in 1976 by German economist and sociologist Adolph Lowe. Here the term 'technological unemployment' appears many times throughout the book. Besides, being also a sociologist, Lowe is capable of keeping a distance from main economic schools (neo-classical, neo-Marxian, Keynesian) in order to assess the controversy from a different point of view: "By centering our investigation of the traverse on the compensation of technological unemployment, we emphasize an issue the relevance of which is highly controversial. It has been debated for more than 150 years

and, considering the secular employment trend over this period, it is not surprising that, in the view of the majority of experts, technological unemployment is today regarded as perhaps an occasional irritant but not as an ever-present threat to the stability of the system. Moreover, in the heat of polemics, the arguments on either side have occasionally been overstated. What is still worse, the basic question at issue has been blurred. This question is neither whether, as a rule, nonneutral innovations initially create unemployment (they do) nor whether, given sufficient time, compensation is possible (it certainly is). The question is whether a free market is endowed with a *systematic mechanism that assures compensation within the Marshallian short period*, thus precluding any secondary distortions that could upset dynamic equilibrium" (Lowe 1976: 250).

The literature on the topic appears much richer also if we take into account books and articles written in different languages. For instance, though being a technological optimist, French economist Jean Fourastié wrote much *sur le risque de chômage technologique de masse* (1949, 1954). Given the parameters of this work, however, we decided to limit our analysis to a few contributions in the English language. More details about the debate on technological unemployment in the Anglo-Saxon culture, with particular attention to the interwar period, can be found in the works by Gregory R. Woirol (1996, 2006).

To put it briefly, while marginalist economists keep denying the problem of technological unemployment, Keynesians are sure that the problem exists, but they are also confident that it can be solved with opportune public policies.

8. REAGANOMICS: THE NEW DENIAL

After the Great Depression – which ended many years later thanks to Franklin Delano Roosevelt's New Deal (according to the Keynesians) or to the Second World War (according to the Austrian School) – it seemed impossible that humankind could return to laissez-faire capitalism. Nonetheless, the return of the neoliberal paradigm was successful, a few decades later, with the landing of Margaret Thatcher to Downing Street in 1979 and Ronald Reagan in the White House in 1981.

What happened next to their policies was not, of course, the end of work, that is the permanent global unemployment of the masses. In spite of the fact that amazing innovations – innovations that in the 1930s belonged only to the sphere of science fiction – have been introduced in the productive system, there are still jobs around. However, it must be adequately stressed that the danger of chronic unemployment has been averted only thanks to the

flexibility of salaries and job market, in full accordance with the theory of marginal analysis.

To give just an example of the new attitude toward automation and unemployment, I will quote some fragments from the article "Does More Technology Create Unemployment?" by R. H. Mabry and A. D. Sharplin, which appeared in 1986. This is the incipit: "Each new generation brings the reemergence of many of the fears of the past, requiring the repetition of old explanations to put them to rest. Today there is a renewed concern that technological advancement may displace much of the manufacturing (and other) work force, creating widespread unemployment, social disruption, and human hardship. For example, in 1983 the Upjohn Institute for Employment Research forecast the existence of 50,000 to 100,000 industrial robots in the United States by 1990, resulting in a net loss of some 100,000 jobs" (Mabry and Sharplin 1986).

The authors intend to refute "all these claims and predictions and the rhetoric that surrounds them." They call rhetoric the discourse strategy of the Keynesians, but in fact their textual approach to the problem presents also the typical rhetoric of scientific discourse. For instance, they try to present themselves as equidistant from both conservatives and progressives – and therefore somewhat neutral or purely scientific. Indeed, they explicitly distance themselves from "conservative economic thinkers", who "tend to disparage persons who fear the rapid advance of technology by labeling them 'Luddites'." This is said to be a term "both unfair and inaccurate." However, a few lines below, they seem to justify the characterization of progressives as Luddites. They state that at least "[i]n part, opposition to technology springs simply from a more or less visceral fear of scientism, which is often taken to imply the dehumanization of humankind."

Again, they try to regain a fair position in the debate by recognizing that "the warnings heard today are thoughtful and well intentioned", but, in the same sentence, they immediately underline that the theorists of technological unemployment are "often in error or somewhat self-serving." This narrative implies that the deniers of technological unemployment are not self-serving. After a few sentences aimed at showing a more balanced attitude toward the problem, Mabry and Sharplin simply restate the standard position of orthodox political economy: "Flatly in error are those that predict no more jobs for a very large sector of the population as a result of advancing technology, creating a massive problem of involuntary unemployment. It is not at all clear that a large number of jobs are about to be destroyed; even if they were, such long-run unemployment as would occur would certainly not be involuntary. Rather, it would take the form of even shorter work days, shorter work-weeks, and fewer working members in the family, as it has throughout our history. Some who correctly anticipate that technological change

may produce short-run employment-adjustment problems overstate those problems. They also often fail to mention that the short-run unemployment that occurs is primarily the result of artificial imperfections -- a lack of competition -- in certain labor and product markets."

Briefly, according to the authors, there is not long-run involuntary unemployment, while short-run unemployment is not caused by technological advancement but by public policies. In a regime of laissez-faire capitalism, people would immediately find new jobs and enjoy technological advances by working less and earning more.

9. Artificial Intelligence: The Specter of Jobless Society

Has this 1980s prophecy been fulfilled in the following decades? By the end of the twentieth century, a legion of social scientists answers negatively to the question. The specter of a jobless society reappears in books such as *The End of Work* by Jeremy Rifkin (1995), *Progress without People* by David F. Noble (1995), and *Turning Point* by Robert U. Ayres (1998). The alarm takes a larger magnitude if we consider also the publications in other languages. For instance, Italian sociologist Luciano Gallino has written much, in his own mother tongue, about technological unemployment (1998, 2007).

The narrative of this wave of social criticism can be summarized as follows: the introduction of computers and robots in factories and offices, in the last forty years, has led to the enrichment of a minority and the insecurity and impoverishment of the majority. There are still jobs on the market, because machines, at their present stage of development, cannot completely replace labor. They can only complement it. Jobs that do not disappear completely are those involving a physical effort that cannot be defined by a tractable list of rules and, therefore, cannot be easily implemented in a machine, or those that are so humble and low paid that, even when their automation is technically possible, it is still more economical to hire humans. However, it is just a matter of time. In the near future, machines will be able to replace humans in any activity. Therefore, a profound reform of our society is needed and urgently.

Social scientists with this viewpoint have occasionally attracted the accusation of 'intellectual Luddism.' A similar accusation could not, however, be raised against a second wave of social criticism arising a few years later, given that its exponents are mainly engineers and computer scientists. An explosion of publications on Artificial Intelligence, seen as the demiurge of a jobless society, takes place after the 2008 financial crises. Authors like Martin Ford (2009, 2015), Erik Brynjolfsson and Andrew McAfee (2012, 2016), Stan Neilson (2011), Jerry Kaplan (2015), just to mention a few, are deeply

convinced that technology is a 'good thing,' but it cannot but render human beings obsolete. Therefore, the only way to avoid an epochal catastrophe is to redesign our societies, starting from the basements, in order to make place for both humans and machines.

These authors tend to underline that our own is an epoch of painful transition, but a 'golden age' of humankind is visible at the horizon. We just need to realize that technology is not just a tool of this or that politico-economic system, but rather the actual *primum movens* of human history. A *primum movens* which requires its own politico-economic system to work at its best. The introduction of a basic income guarantee (BIG) – that is, an income to be assigned *unconditionally* to all citizens of industrial countries – is among the various proposed solutions (Hughes 2014, Campa 2014b).

The idea of a *radical societal change*, which has been buried for a few decades in the cemetery of dead ideas, could resuscitate thanks to the crisis of neoliberalism following the 2008 global financial bankruptcy. A crisis that, in the words of sociologist Luciano Pellicani (2015: 397), "has demonstrated the technical – as well as moral – absurdity of the neoliberal paradigm, centered on the idea of self-regulated market." With the addition that the markets are self-regulating only for the lower classes, given that bankers and capitalists can systematically count on bailouts and public money when something goes wrong.

Among the signs that what Ludwik Fleck called *Denkkollektiv* is changing, we can mention the Nobel Prize for economics assigned in 2008 to Keynesian economist Paul Krugman, who afterwards has also expressed his worries about technological unemployment (2013). Or, perhaps, the planetary success of a book like *Capital in the 21st Century* by Thomas Piketty (2013).

All the optimism of the 1980s has vanished. According to the abovementioned analysts, the present transition phase is characterized by involuntary unemployment due to automation and precarious jobs due to flexibility policies. True, many jobs have not yet been automatized. In the tertiary sector, we observe a proliferation of caregivers assisting elderly and disabled at home, bellhops, call center operators, waiters, fast foods workers, pizza deliverers, employees of cleaning companies, atypical taxi drivers, external collaborators with VAT registration, refuse collectors, private mail carriers, storekeepers, shop assistants, etc. In many cases, employers still find it more cost effective to hire uneducated workers or desperate immigrants than mechanizing these jobs (assuming that a machine is available or can be designed to do it).

However, what is clear is that all-life and full-time jobs – such as jobs in large factories and public offices – which used to be the prerogative of middle class workers, have significantly shrunk in number as in the level of re-

muneration. Observers seem to be amazed at this phenomenon, as illustrated by a recent article published in *The Wall Street Journal*: "The typical man with a full-time job–the one at the statistical middle of the middle–earned $50,383 last year, the Census Bureau reported this week. The typical man with a full-time job in 1973 earned $53,294, measured in 2014 dollars to adjust for inflation. You read that right: The median male worker who was employed year-round and full time earned *less* in 2014 than a similarly situated worker earned four decades ago. And those are the ones who had jobs" (Wessel 2015).

This is what we read in 'the bible of capitalism,' not in a blog of angry radicals. However, it is not surprising that today workers earn on average less than their fathers or grandfathers, despite all the progress made by humanity in the meantime, if we keep in mind that the theory of compensation does not say that thanks to technological progress we will all live happily ever after. The theory says that there will be no mass unemployment, if the governments guarantee wage flexibility. The negative side effect of this policy becomes what we might call 'technological impoverishment.'

Moreover, the automation of the tertiary sector is also relentlessly taking place. We already hear of pizza delivery by means of drones, of autonomous vehicles on the roads, of chirurgical interventions made by robots, etc. Occasional households have been replaced by cleaning robots in many homes, software substitute for lawyers (Pasquale & Cashwell 2015), the robotization of the military is in a very advanced phase (Campa 2015), and the automation of social work has also started (Campa 2016). So, it is not surprising that specialist economic literature is now taking seriously the issue of technological unemployment (Feldmann 2013, Feng & Graetz 2015).

This does not mean that compensation theory has disappeared from public discourse, but even those analysts still moving in the wake of orthodox economics do not dismiss the hypothesis of mass technological unemployment when talking about the future. For instance, in May 2013, the McKinsey Global Institute published a detailed study of a dozen new technologies defined 'disruptive' for their potential impact on the economy. The report is generally optimistic, because it focuses on the chances offered by technological advances to big corporations. However, it also recognizes that "productivity without the innovation that leads to the creation of higher value-added jobs results in unemployment and economic problems, and some new technologies such as the automation of knowledge work could significantly raise the bar on the skills that workers will need to bring to bear in order to be competitive" (Manyika 2013: 151). In a 164-page report, the word 'unemployment' appears only once, but at least there is no denial of the problem.

The report assumes that policy makers can limit the negative side effects of advanced robotics and automated knowledge work by improving and re-

newing education. In other words, they "should consider the potential consequences of increasing divergence between the fates of highly skilled workers and those with fewer skills," and keep in mind that "[t]he existing problem of creating a labor force that fits the demands of a high-tech economy will only grow with time" (ibid.).

This is the old recipe of neoliberalism: one does not need the redistribution of wealth to cope with unemployment and impoverishment; one just needs better educated citizens and workers. If in the short term workers may experience problems, in the long term innovation will result in the creation of new higher value jobs. The report maintains that also workers will take advantage of automation. Nonetheless, it is easy to demonstrate that these 'potential benefits' could be turned into 'potential threats' by simply expressing them with different words. Let us give an example. At page 7, we read what follows: "It is now possible to create cars, trucks, aircraft, and boats that are completely or partly autonomous. From drone aircraft on the battlefield to Google's self-driving car, the technologies of machine vision, artificial intelligence, sensors, and actuators that make these machines possible is rapidly improving. Over the coming decade, low-cost, commercially available drones and submersibles could be used for a range of applications. Autonomous cars and trucks could enable a revolution in ground transportation—regulations and public acceptance permitting. Short of that, there is also substantial value in systems that assist drivers in steering, braking, and collision avoidance. The potential benefits of autonomous cars and trucks include increased safety, reduced CO2 emissions, more leisure or work time for motorists (with hands-off driving), and increased productivity in the trucking industry" (Manyika 2013: 7).

As you can see, McKinsey analysts predict a remarkable productivity growth and, among benefits, more *free time* or *working hours* for motorists, due to lower mental and physical fatigue. By using a most brutal language, we may say that the 'benefits' for workers will be more *unemployment* or *exploitation*.

10. Conclusions

This debate seems to teach us that, in a *laissez faire* capitalist economy, the choice boils down to two perspectives: 1) if one introduces policies to safeguard the standard of living of workers by establishing that the minimum wage cannot fall below a certain threshold (moderate left policy), the system produces 'technological unemployment;' 2) if it is established that the government must not interfere in negotiations between capitalists and workers, letting the market decide wage levels (moderate right policy), the system

produces 'technological impoverishment.' All this happens when an impressive technological development may *potentially* improve the life condition of everybody. Thus, contemporary society seems to be inherently characterized by a 'technological paradox.'

Traditional political forces converge on the idea that improving education could be the 'weapon' to contrast technological unemployment. However, not much attention is paid to the fact that Artificial Intelligence develops exponentially and not only promises to further reduce the workforce in manufacturing, but it will begin to erode the work of specialists in the service sector. In the near future, unemployment could concern economic actors who have attended higher education institutions and invested much time and money to acquire their professional skills, such as journalists, physicians, teachers, lawyers, consultants, managers, etc.

Typically, those who bring attention to the 'technological paradox' characterizing our society are immediately halted with a rather trivial argument: the historically known alternative systems to capitalism – namely: feudalism, fascism, and communism – have failed. But this is stating the obvious. To displace this rhetorical argument, the paradox can be better expressed by the following question: How can it be that sentient beings capable of inventing quantum computers and creating artificial life fail to come up with *a new system* of production and consumption in which these and other innovations, if they cannot be beneficial to all individuals at the same extent, at least are not detrimental to the majority?

BIBLIOGRAPHY

Black, John, Nigar Hashimzade, and Gareth Myles. 2012. *A Dictionary of Economics*. Oxford: Oxford University Press.

Blaug, Mark. 1958. *Ricardian Economics*: *A Historical Study,* New Haven: Yale University Press.

Brynjolfsson, Erik, and Andrew McAfee. 2012. *Race Against the Machine: How the Digital Revolution is Accelerating Innovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy*. Lexington MA: Digital Frontier Press.

Brynjolfsson, Erik, and Andrew McAfee. 2016. *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*. W. W. New York and London: Norton & Company.

Campa, Riccardo. 2007. "Considerazioni sulla terza rivoluzione industriale." *Il pensiero economico moderno*, Anno XXVII, n. 3, Luglio-Settembre: 51-72.

Campa, Riccardo. 2014a. "Workers and Automata: A Sociological Analysis of the Italian Case." *Journal of Evolution and Technology*, Vol. 24, Issue 1, February: 70-85.

Campa, Riccardo. 2014b. "Technological Growth and Unemployment: A Global Scenario Analysis." *Journal of Evolution and Technology*, Vol. 24, Issue 1, February: 86-103.

Campa, Riccardo. 2015. *Humans and Automata: A Social Study of Robotics*. Frankfurt am Main: Peter Lang.

Campa, Riccardo. 2016. "The Rise of Social Robots: A Review of Recent Literature." *Journal of Evolution and Technology*, Vol. 26, Issue 1, February: 106-113.

Carboni, Carlo. 2015. "Partita tecnologica sul lavoro." *Il Sole 24 Ore*, May 1st.

Douglas, Paul H. 1930. "Technological Unemployment." *American Federationist,* August.

Durand, Jean-Pierre. 1995. *La sociologie de Marx*. Paris: La Découverte.

Feldmann, Horst. 2013. "Technological Unemployment in Industrial Countries." *The Journal of Evolutionary Economics,* Volume 23, Issue 5: 1099-1126.

Feng, Andy, and Georg Graetz. 2015. "Rise of the Machines: The Effects of Labor-Saving Innovations on Jobs and Wages." *Centre for Economic Performance LSE*, Discussion Paper no. 1330: 1-55.

Ford, Martin. 2009. *The Lights In the Tunnel: Automation, Accelerating Technology and the Economy of the Future*. USA: Acculant™ Publishing.

Ford, Martin. 2015. *Rise of the Robots: Technology and the Threat of a Jobless Future*. New York: Basic Books.

Fourastié, Jean. 1949. *Le Grand Espoir du XX° Siècle. Progrès technique, progrès économique, progress social*. Paris: PUF.

Fourastié, Jean. 1954. "Quelques remarques sur le chomage technologique et notamment sur la distinction entre deux types de progrès technique, le progrès processif et le progrès récessif." In *Études européennes de population: manin-d'oeuvre, emploi, migrations: situation et perspectives*. Paris: Éditions de l'Institut National d'Études Démographiques.

Gallino, Luciano. 1998. *Se tre milioni vi sembran pochi. Sui modi per combattere la disoccupazione*. Torino: Einaudi.

Gallino, Luciano. 2007. *Tecnologia e democrazia. Conoscenze tecniche e scientifiche come beni pubblici.* Torino: Einaudi.

Haberler, Gottfried. 1932. "Some Remarks on Professor Hansen's View on Technological Unemployment." *The Quarterly Journal of Economics,* Vol. 46, No. 3, May: 558-562.

Hagen, Everett E. 1942. "Saving, Investment, and Technological Unemployment." *The American Economic Review,* Vol. 32, No. 3, Part 1, September: 553-555.

Hansen, Alvin. 1931. "Institutional Frictions and Technological Unemployment." *The Quarterly Journal of Economics,* 45, August: 684-698.

Hughes, James. 2014. "Are Technological Unemployment and a Basic Income Guarantee Inevitable or Desirable?" *Journal of Evolution and Technology*, Vol. 24, Issue 1, February: 1-4.

Kaplan, Jerry. 2015. *Humans Need Not Apply: A Guide to Wealth and Work in the Age of Artificial Intelligence.* New Haven: Yale University Press.

Keynes, John Maynard. 1963 [1930]. "Economic Possibilities for our Grandchildren." In J. M. K., *Essays in Persuasion*. New York: W. W. Norton & Co.: 358-373.

Krugman, Paul. 2013. "Sympathy for the Luddites." *The New York Times,* June 13th.
Kurz, Heinz D. 1984. "Ricardo and Lowe on Machinery." *Eastern Economic Journal* Vol. 10 (2), April-June: 211-229.
Lefebvre, Henri. 1982 [1968]. *The Sociology of Marx*. New York: Columbia University Press.
Mabry, Rodney H., and Arthur D. Sharplin. 1986. "Does More Technology Create Unemployment?" *Policy Analysis*, No. 68, March 18th.
Manyika, James, et al. 2013. *Disruptive Technologies: Advances that will transform life, business, and the global economy*. McKinsey Global Institute.
Marx, Karl. 1976 [1867]. *Capital: A Critique of Political Economy*. Harmondsworth: Penguin Books.
Montani, Guido. 1975. "La teoria della compensazione." *Giornale degli Economisti e Annali di Economia,* Nuova Serie, Anno 34, No. ¾, Marzo-Aprile: 159-192.
Neilson, Stan. 2011. *Robot Nation: Surviving the Greatest Socio-economic Upheaval of All Time*. New York: Eridanus Press.
Neisser, Hans P. 1942. "'Permanent' Technological Unemployment: 'Demand for Commodities Is Not Demand for Labor'." *The American Economic Review*, Vol. 32, No. 1, Part 1, March: 50-71.
Pasquale, Frank, and Cashwell, Glyn. 2015. "Four Futures of Legal Automation." *63 UCLA Law Review Discourse*, 26: 26-48.
Pellicani, Luciano. 2015. *L'Occidente e i suoi nemici*. Soveria Mannelli: Rubbettino.
Ricardo, David. 2004 [1821]. *On the Principles of Political Economy and Taxation*. Kitchener: Batoche Books.
Schumpeter, Joseph A. 2006 [1954]. *History of Economic Analysis*. Taylor & Francis e-Library.
Smelser, Neil J. 1976. "On the relevance of economic sociology for economics." In *Economics and Sociology: Toward and Integration*, edited by T. Huppes. Dordrecht: Springer Science+Business Media: 1-26.
Smith, Adam. 1998 [1776]. *An Inquiry into the Nature and Causes of the Wealth of Nations*. London: The Electric Book Company.
Steuart, James. 1767. *An Inquiry into the Principles of Political* Economy. London: Printed for A. Millar, and T. Cadell, in the Strand.
Stuart Mill, John. 2009 [1848]. *Principles of Political Economy*. Project Gutenberg TEI edition.
Swedberg, Richard. 1987. "Economic Sociology: Past and Present." *Current Sociology*, 35, March 1st: 1-144.
Wessel, David. 2015. "The Typical male U.S. Worker Earned Less in 2014 Than in 1973." *The Wall Street Journal*, September 18th.
Wicksell, Knut. 1977 [1934], *Lectures on Political Economy*, Fairfield: Augustus M. Kelley Publisher.
Wladawsky-Berger, Irving. 2015. "Technological Unemployment and the Future of Work." *Wall Street Journal*, November 6th.
Woirol, Gregory R. 1996. *The Technological Unemployment and Structural Unemployment Debates*. Westport: Greenwood Press.
Woirol, Gregory R. 2006. "New Data, New Issues: The Origins of the Technological Unemployment Debates." *History of Political Economy*, 38(3): 473-496.