EVALUATION OF THE IMPACT OF THE 4TH INDUSTRIAL REVOLUTION ON THE LABOR MARKET

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Abstract

The paper explores the content and implications of the 4th industrial revolution, both as a concept and as a reality, particularly from the point of view of the human factor. The analysis highlights the key differences between the current industrial revolution and the previous ones, particularly from the point of view of the labor market. Three characteristics of the 4th industrial revolution are identified: ubiquity, availability and interaction at a global scale. Due to the large disruptive potential of the 4th industrial revolution the paper is focused on the implications and the possible solutions for rethinking the place of the human factor in the economic process but also in society in the context of the large scale use of Internet of Things (IoT), robots and artificial intelligence.

Key words: 4th industrial revolution, labor market, human factor and economic process

JEL classification: O14, O25, O33, O38

The relation between technology and human activities

Technology as a concept may be defined as "the practical application of knowledge especially in a particular area" (Merriam-Webster, 2017). This brief definition can be easily applied to ancient Egypt as well as to contemporary economies and societies. As such, technology implies the pre-existence of a certain knowledge, as well as the practical application of that knowledge. From this point of view technology may be regarded as an interface between science and the real daily life.

Some practical applications of knowledge are useful, but at the same time limited in their impact on human existence. For instance, the lightning rod applies the knowledge about electricity for preventing the buildings from lightning strikes and its principle of functioning was described by Benjamin Franklin in 1749 (Jernegan, M.W., 1928). Such a technology prevents a number of fire hazards and other damages but it is not really changing the economy or society. Different from the technology that represent the foundation for the lightning rod, the technology related to the steam engine, particularly after its improvement by Thomas Newcombe in 1712 and James Watt in 1781, laid the foundation for the first industrial revolution (Whipps, H., 2008) that changed not only the economy of the Western world but also the Western society by creating the large scale industrial production, the development of transport (by railways and also by river and sea), the development of cities and urban life, the change of education and, in the end, the perception about the world and the world economy as a whole.

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The difference between the two types of knowledge and the technologies that apply that knowledge (**evolutionary** and **revolutionary**) is included in the concepts of scientific revolution and paradigm shift proposed by Thomas Kuhn (Kuhn, T., 2012) that challenged the previous belief that progress is mainly a linear process based on accumulation of knowledge and know-how and replaced it with a non-linear process that alternate in an irregular way periods of linearity ("normality) with moments of discontinuity ("scientific revolutions").

When moments of discontinuity appears (the scientific revolutions and their technological replicas) the economy and society passes through significant transformations (that involve work, education, values and many other aspects).

In this context, among many other things, the first industrial revolution raised for the first time in human history the question **of the impact of technology on human labor** not only from the point of view of reducing the physical effort of workers and of tremendously increasing the productivity and output, but also from the point of view of the risk of eliminating human labor because of replacing it with mechanical equipment.

Such was the fear of the risk of skilled workers in textile industry for being replaced by machines that during 1811 – 1813 the so-called Luddites movement took place in Midlands, Yorkshire and Lancashire and manifested by burning factories and smashing weaving machines (Andrews, E., 2015).

In retrospect the fears of the Luddites did not materialize and while the mechanical tools and equipment brought by the first industrial revolution as well as by the second and third ones eliminated certain jobs, many others were created and economy and society dramatically improved and progressed.

The 200 years experience with technology since the Luddites movement has been mostly positive: many human activities are nowadays much less demanding from a physical point of view, many opportunities emerged all over the world and amazing information and communication technologies are widely available. This is why so many people today are techno-enthusiast (sometimes even without being aware of this) and seem to rely on the saying: "Come what may, we shall find a way." Maybe the only widely accepted negative implication related to the large scale use of technology is the one related to the impact of technology on the environment, particularly in relation to climate change.

The impact of technology on economy and society is anyway much more complex and does not limit in any way to the labor market. In this sense a profound observation is that the large scale implementation of technologies determine two opposing forces: **the diffusion of economic benefits** and **the concentration of wealth** (Buckup, S., 2017).

The manifestation of the two opposing forces is **to a large extent sequential**. The large scale implementation of technologies creates jobs, requires larges quantities of raw materials and energy, generates the emergence of new companies, generates new wealth and raises the living standards of large number of people. Due to all these phenomena specific to the early and middle stages of an industrial revolution new social classes and/or political forces may appear and the economic development may lead to social and political developments. In the late (mature) stages of an industrial revolution a concentration of power occurs due to the phenomenon of concentration of capital which is then translated into a concentration of political power. While in previous historical periods the concentration of power took the form of authoritarian regimes, nowadays

especially in the Western world the concentration of power may take the form of gradual adoption of rules of the game (institutions and legislation) that favor substantially the more affluent part of society (Sparrow, J., 2017).

The 4th industrial revolution as a concept and as reality

Industrial revolutions can be regarded as moments of change and disruption in multiple areas related to society and economy. They are based on the evolution of human knowledge and may change values, behaviours, the management of economic activities and the balance of power on a regional or global scale. Industrial revolutions may also significantly affect environment as they require certain resources and generate different outputs, some of them useful, such as products and services, and some of them with a negative impact on the environment, such as waste, air pollution or the climate change.

In this context, Klaus Schwab, the founder of the World Economic Forum and author of a book on the 4th industrial revolution mentioned that: The term "revolution", be it related to industrial area ("industrial revolution") or to science and technology ("technical-scientific revolution") implies "abrupt and radical change", a change that takes place in a sudden way (Schwab, K., 2016, p .11). The key aspect here is **the idea of radical change** which differentiates industrial evolutions (that are mere improvements) from industrial revolutions that are not only allowing the carrying out of economic and social activities on a much larger scale, but also allow the carrying out of these activities in a different way (for instance by means of mechanization, automatization or completely automated processes).

Such revolutions took place either **when new technologies** (such as the discovery of fire or of the wheel or, more related to modern times, the invention of the printing press, the steam engine or electricity) were discovered and implemented on a large scale or **when new perceptions related to the world** (like that determined by Galileo Galilei and Nicolaus Copernicus which replaced the belief originating in antiquity that the Universe/our galaxy is organized around the Earth with the belief that the planets in our galaxy are revolving around the sun) have determined profound changes in the economic systems and social structures.

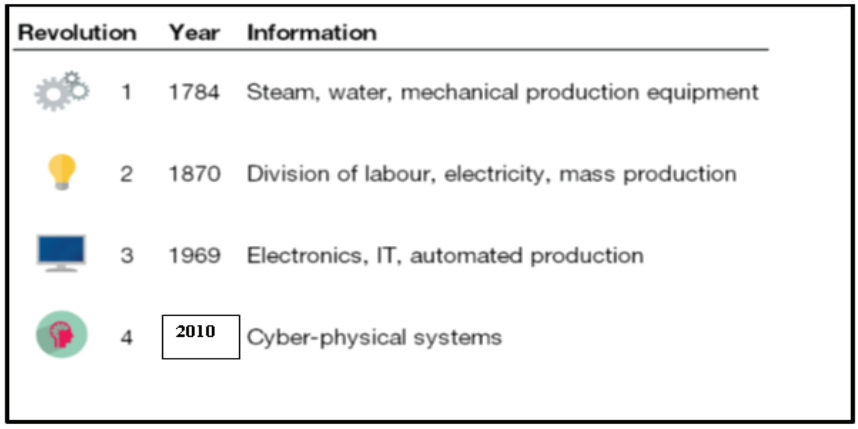
An important observation based on the historical experience is that revolutions are not emerging and affecting the whole world at the same time, given the fact that even in the same country the dissemination of a new perception about the world or of a new technology are not linear or all encompassing processes.

With the exception of researchers and historians that kept record of the successive industrial revolutions, the vast majority of people have been aware only of the 1st industrial revolution that started to manifest in late 18th century because that revolution at the same time changed the previous economic and social order and defined the main characteristics of what we know as the Western civilization. In fact, the impact of that 1st industrial revolution has been so great for the design and maturity of the Western civilization that a reputed historian, Robert Gordon stated that all important discoveries had already been done and what remains are only incremental improvements (Gordon, R., 2016, p.109).

This is why if we analyze the 4th industrial revolution it is useful to frame it in the more general context of the previous ones both as regards the timing and the content and implications for economy and society.

Therefore the time perspective and the brief description/content of the 4 industrial revolutions are presented in Figure 1 below.

Figure 1 The 4 industrial revolutions - their historical periods and content



Source: Adapted from Davis, N. – What is the fourth Industrial Revolution, World Economic Forum, 2016

As industrial revolutions are complex phenomena that affects first knowledge and science, then technology, then business, then education and finally society and its values they can not be related to a single year and a single place.

Some authors anyway tend to indicate a certain year as corresponding to a certain industrial revolution but their intention (which is not always explicit) is to mark the date when a certain scientific and technological discovery was commercially applied for the first time. With reference to the above figure:

- Year 1784 corresponds to the use of first mechanical loom in textile workshops;
- Year 1870 corresponds to the use of first production line in a Cincinnati slaughterhouse;
- Year 1969 corresponds to the use of the programmable logic controller (PLC), Modicon 084;
- And the period since 2010 corresponds to the ever larger use of cyber-physical systems (CPS) or large scale-complex automation.

While the 4th industrial revolution is in its early stages and can not be described in detail, anyway some characteristics can be mentioned:

- the use of artificial intelligence and of robots in an increasing number of areas that are not limited to business, but includes health care, education and even culture;
- the Internet of Things that connects more and more devices both in the business and domestic areas in such a way that almost everybody & everything becomes part of a global network ;
- the capacity to collect and process huge amounts of data beyond human capabilities (the so-called Big Data).

What may be regarded as a specific characteristic of the 4th industrial revolution is that new technologies and a new level of knowledge are available simultaneously to almost all the population of the globe while at the same time all these new technologies and knowledge can connect, communicate and inter-act with each other and, in the process, further generate new technologies and new knowledge.

In our opinion **ubiquit**y, **availability** and **interaction at a global scale** are the three main characteristics of the 4th industrial revolution.

Impact of the 4th industrial revolution on the labor market

A lot of debates took place in the scientific circles and the media on the impact and implications of the 4th industrial revolution on labor and two antagonistic positions could be remarked. One is that the 4th industrial revolution will dramatically impact the labor market and in general the human role in the economic process. The other position is that as humankind already passed through 3 previous industrial revolutions without significant or long lasting disruptions on the labor market, most probably the developments will be similar for the 4th one.

Anyway, a more attentive analysis points out to some differences between the 4th industrial revolution and the previous ones. Following such analysis the conclusion is that the 4th industrial revolution will influence the labor market in a way that is different from the previous ones. In essence, what is different is that the 4th industrial revolution will impact everybody at the same time and will also change the nature of production.

The first industrial revolution disrupted some jobs in agriculture and low value added processing industries but allowed the disrupted workers to find industrial jobs that still had a strong physical component. The second industrial revolution created more industrial jobs and an increasing number of office jobs. The third industrial revolution reduced significantly the number of industrial jobs but more than compensated with jobs created in the office sector (the generic services sector). Therefore in the first and second industrial revolutions the labor had to adapt to different types of physical labor and then, in the third revolution, to adapt more and more to intellectual jobs (jobs based on information processing and knowledge). What the 4th industrial revolution is doing is that it has the potential to eliminate not only physical jobs but also intellectual jobs.

Therefore while in the previous industrial revolutions (one to third) labor has a space to move from one type of activity to another (from heavy physical labor to less demanding physical labor and then to intellectual labor) in the 4th industrial revolution labor seems to be with its back against the wall. There is no new space to relocate. People with a large vision and expertise, as Bill Gates thinks that the promising jobs for the future will be in the fields of artificial intelligence, energy and biosciences (Kincks, J., 2017). The problem is that such areas can not create millions and billions of jobs and the capability to pursue such careers is not open to everyone.

From another perspective, according to Klaus Schwab there are three reasons why the 4th industrial revolution is different and they refer to (Schwab, K., 2016, p.8):

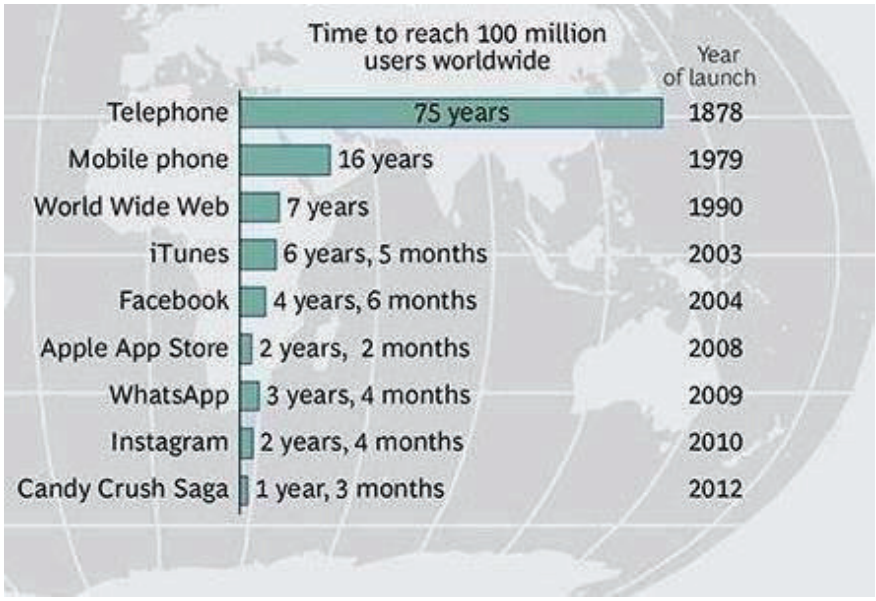
– the speed of propagation;
– the scope of change and impact;
– the impact on economic and social systems.

The speed of propagation of the 4th industrial revolution is remarkable because it develops and disseminates in an exponential pace while the previous revolutions evolved in a linear way. This dramatic increase of the speed of propagation is exemplified in Figure 2.

The scope of change and impact determined by the 4th industrial revolution are also unprecedented because they include all areas of human existence and almost all areas of the globe.

Because the speed of propagation is very high and because almost all areas of human existence are affected the transformations determined by the 4th industrial revolution have the potential to change the way economic activities are carried out, the management procedures and the governance at all levels, public or private.

Figure 2. Time to reach 100 million users



Source: Dreischmeier, R.; Close, K.; Thichet, P. – The Digital Imperative, Boston Consulting Group, April 2015, p. 6

The assumptions that the 4th industrial revolution will have a very significant impact on the labor market are based on the fact that it can automate industrial, services and even creative activities.

The possibilities opened by the technological breakthroughs such as artificial intelligence, robotics, the Internet of Things, autonomous vehicles, 3-D printing, nanotechnology, biotechnology, materials science, energy storage, and quantum computing seem endless and they appear to create a very divisive world: **a limited number of people** will use these knowledge and instruments and **a vast majority** may become more or less redundant.

Some estimations on the impact of the 4th industrial revolution on the labor market generated a lot of reactions. And even if we take these estimates with a grain of salt, they have anyway the potential to rise some preoccupation. In this respect, according to a study made by

Bank of England in the next 10-20 years automation may eliminate about 80 million jobs in USA and 15 million jobs in Great Britain; the mentioned figures represent about 50 % of the workforce in the two countries (Haldane, A., 2015). Other estimates originating with Forbes indicate the elimination of 35 - 50% of the workforce of the two countries in the same time interval (Marr, B., 2017).

World Economic Forum indicated that until 2020 in the main 15 developed and developing countries (which have together 1.9 billion jobs or 65 % of world total) about 5 million jobs will be eliminated by technologies in the fields of genetics, AI, robotics. It is to be mentioned any way that the loss of 5 million results from a 7 million loss and 2 million new jobs created by technology.

A common sense perception would be that the most developed countries could be the most affected by the 4th industrial revolution because we tend to associate the idea of industrial revolution with the most advanced countries. Anyway, in the context of globalization and global inter-connection and inter-dependence the implications are quite different. A recent UNCTAD report together with a World Bank study stated that developing countries may have the main losses of jobs due to the use of robots. For this group of countries the loss of jobs can be as big as 2/3 of total jobs, mainly because in the initial phase the robots will replace low and medium skilled jobs, exactly the types most found in developing countries (UNCTAD, 2016).

Is China a possible model for the pro-active response to the 4th industrial revolution?

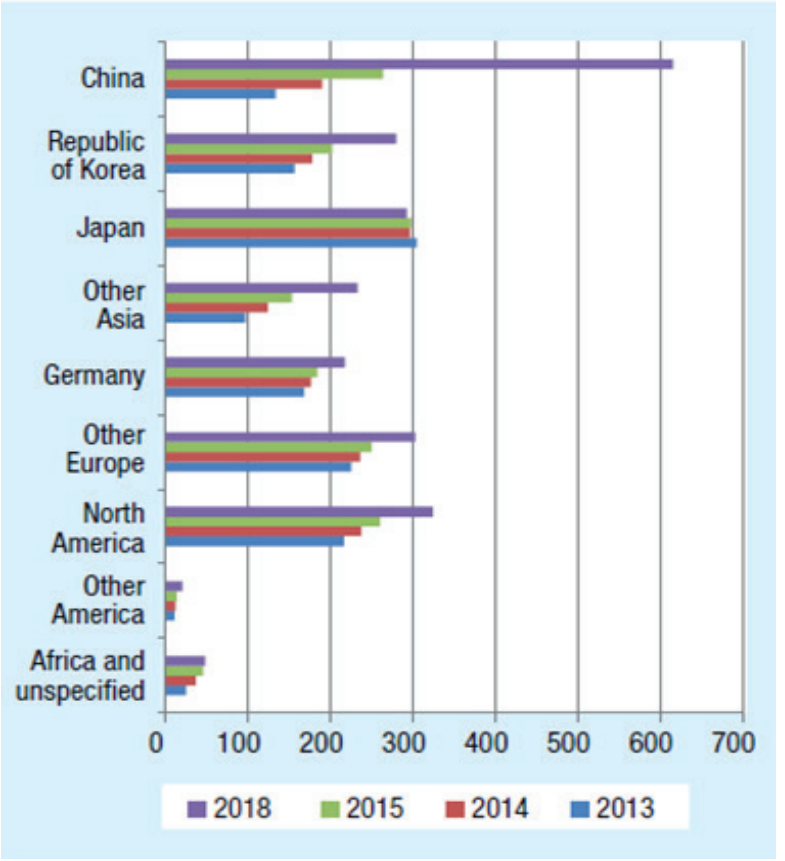
China has the largest population in the world and it is also the undisputed performer of long term economic growth. These two facts make of interest the reaction of China to the 4th industrial revolution which has such a great potential of eliminating jobs. Despite this risk, China seems not to attempt the avoidance or delay of the 4th industrial revolution, on the contrary China seems to accelerate its manifestation.

The Chinese response to the emergence of the 4th industrial revolution took into account primarily the reduction of working-age population and the rising of labor costs. In this context China has started in 2013 a government industrial strategy based on the use of robots, named "Made in China 2025" (Bradsher, K., Mozur, P., 2017). According to UNCTAD since 2013 China has bought more industrial robots than any other country and as result by the end of 2016 China became the world's largest operator of industrial robots UNCATD, 2016) – Figure 3.

Given the large population of China the number of robots per industrial worker will remain lower than in other countries such as Japan, Germany or South Korea but the robotization of Chinese production will compensate for the increase in salaries.

At the same time, as China has as a goal to become a leader in scientific research and technological innovation, the Chinese strategy has in view to transform the country into a major producer and exporter of industrial robots. In this context the Chinese government has in view increase 3 times the annual production of industrial robots by 2020 as compared to 2015, increasing the number from less than 33,000 to over 100,000 (Xinhua, 2016).

Figure 3 .Estimated operational stock of industrial robots in some countries during period 2013 - 2018 - thousand of units



Source: UNCTAD, Policy in Brief, No. 50/October 2016, Robots and industrialization in developing countries

Such coordinated and fast changing movements as possible in China as the economy is to a large extent a market economy but under a tight control of the government and this particular combination allows for concentration of efforts and resources and, at the same time, the avoidance of uncontrolled disequilibria.

Conclusions

The 4th industrial revolution will be pervasive and more challenging than the previous ones because will affect almost all population of the globe, all sectors and human activities, economic, social or otherwise. The speed of adoption of the new technologies is very likely to be exponential and therefore the time for adjusting to change will be limited.

According to almost all estimates and forecasts the impact on the labor market will be significant in a decade horizon and beyond, while it is very likely that about 50% of the existing jobs will become redundant.

At the same time, the large scale use of robots will determine the creation of some jobs either characterized by a high value added or by a high human content. The

downside is that such jobs will be concentrated in a limited number of areas and will require rather specialized skills.

The direction (positive or negative) as well as the intensity of the impact of robotization and the use of artificial intelligence will depend to a large extent on the policies adopted by governments. Such policies should support the digitalization of economy and also the design of new education institutions and techniques that will prepare the young generation for the future types of activities that will be carried out 10 to20 years from now.

The public policies adopted as response to the 4th industrial revolution will have to take into account not only the education and formation of workforce but also what happens to that part of the work force and of the population that may have rather long periods of lack of jobs or of temporary jobs. This responses requires large redistributive mechanisms that are yet to be imagined as well as financial source for them. A possible response may be the taxation of the use of robots. Such a tax will provide the governments with funds for social transfers, for supporting people that lose their jobs due to robots and also for sustaining a decent living standards for the people with low and medium qualifications.

Because of the complexity of this transition to a new type of economy and society any sustainable solution will require a full participation of the private sector and of the population in order to transform into a daily reality the classic concept of long life learning processes.

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