The Labor Market in the Digital Age: A New Perspective on Jobs

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Abstract

With the advent of new technology, the labor market has undergone many changes. These changes were perceived differently by people and may even be rejected. The fear that technology will replace human labor has persisted in people's identities since the beginning of the third millennium. Researchers are of different opinions. Some believe that technology will harm social welfare, while others argue that technology only helps to advance society. We accept on the one hand that technology can take over some workloads, but we also accept that technology creates new jobs. We also propose another perspective on this ideological conflict. We support the idea of reconfiguring jobs by optimizing tasks. We want to highlight the power that skills have in the hiring decision and what these skills are much desired by employers. The novelty comes from the way we work with new unstructured data sources to extract new insights. For this, we used the indicators "Skills needs" and "Skill penetration rate". These indicators were calculated by the World Bank in partnership with LinkedIn, based on the TD-IDF text mining methodology. To capture changes over time we used relative (chronological) dynamics indices, and to capture differences between skill categories we applied ANOVA analysis. Thus, we showed how the main industries have changed their preferences in terms of the skills that candidates have. We also highlighted how the importance for soft skills, technological skills and disruptive technological skills has increased. Finally, we presented the growing speed of demand for people with skills for new technologies (artificial intelligence, data science, human computer interaction).

Keywords

Introduction

The general fear of society has been, and continues to be, that technology solutions will be able to replace the human workforce (Ford, 2015). This hypothesis on the one hand can be supported, if we consider some jobs in factories that have been fully automated. We can say rather that it was not the work itself that was automated, but the task that had to be accomplished (Frey and Osborne, 2017). Thus, the researchers described the risk of automating the tasks within the workplace. On the other hand, a partial automation of some activities could be beneficial for the quality of life of the employee, for the efficiency of the activity and even to eliminate the operational risk. There are also many jobs that require high complexity and could not be automated by existing technologies. However, technology is quite beneficial for the economy, helping to improve the internal processes of companies, but also building new areas of activity since the 21st century (Tohănean, et al.,2020). We can say that

the economy is facing a "digital evolutionism". What we want to indicate by this phrase is that like the theory of evolutionism proposed by Charles Darwin or the Big Bang theory, digital technology has an initial point, namely the emergence of von Neumann architecture.

The Industrial Revolution 4.0 comes with a new approach to the labor market. More precisely, the transition is made from the recruitment of the labor force on the consideration of „Job Title", to the recruitment based on matching employee skills with job tasks. This matching ensures more efficient activities and a higher profit for employers. Often job mistmatch occurs due to the lack of human resources on the labor market with certain skills. The rapid evolution of technologies is not supported by the ability of the education system to integrate it. Thus, between the time of supply and demand in the labor market there is a time delay in which the business environment must improvise. This is when the income gap deepens. Those few specialists in the new segments of technology will have much higher incomes. This is, moreover, a normal effect of an unbalanced market. This aspect is also a premise for the phenomenon of labor market polarization supported by some researchers (Maarten and Manning, 2007).

Through this paper we aim to show how the demand behaves with the supply on the labor market and if we observe the creative action of technology. Moreover, we want to highlight the labor market trend towards the new skills-based approach. We will have a predominantly qualitative approach, with elements of quantitative analysis. Finally, we intend to make useful judgments for both future research and possible proposals.

Literature review

In the last century, the topic of the impact of technology development on the labor market has been much discussed. Some researchers have concluded in their work that man is in competition with technology, which will eventually lead to massive unemployment in the labor market and social inequality (Ford, 2015). Others contradict this hypothesis and explain that income inequality can have causes related to "demographics, regulation, worker values, organization practices, and other technologies" (Handson, 2015). There are also others who agree with the hypothesis that technology has created jobs (Peetz, 2019). In general, discussions revolve around the possibility of automating work tasks or even occupations and start from the studies of researchers Frey and Osborne (Frey and Osborne, 2017). In addition to tasks that can be automated, researchers emphasize the potential of growth of the labor market in the area of programming and data analysis, which currently seem quite difficult to automate (Acemoglu and Restrepo, 2020). One study shows that investment in research and development has a net positive impact on employment (Balsmeier and Woerter, 2019). Moreover, education has been shown to reduce the marginal effect of task automation and reduce the wages gap (Kattan, Macdonald and Patrinos, 2021). According to the World Economic Forum, young people entering primary school will now have occupations that do not currently exist (Block, 2018).

If we analyze the data provided by the social platform LinkedIn, for 20 economies, we can identify the main areas in which technology has created new jobs: Data and Artificial Intelligence, Engineering and Cloud Computing, People and Culture, Product Development, Sales, Marketing and Content (World Economic Forum, 2020). These professional clusters are expected to create approximately 6.1 million new job opportunities in the next three years (World Economic Forum, 2020). Even so, in recent years the creation of new opportunities is more difficult to develop than the disappearance of other jobs, which creates an imbalance in the labor market (World Economic Forum, 2020).

Research methodology

The case study undertaken is based on a set of indicators measured at European level in the period 2015-2019. First, we will use the "Skills needs" indicator, which indicates the top 10 most important skills specific to each occupation in the industrial fields: Arts, entertainment and recreation; Financial and insurance activities; Information and communication; Manufacturing; Mining and quarrying; Professional scientific and technical activities (according to the International Standard Industrial Classification - one digit level) (LinkedIn, 2021). Thus, based on them we calculated the relative

frequency of industries in which the main categories of skills can be identified. A second indicator used is "Skill penetration rate", which is calculated based on TD-IDF (term frequency – inverse document frequency) statistics (LinkedIn, 2021). This statistic is used in text mining to prioritize important terms in a collection. TD-IDF also underpins the operation of search engines. To highlight the significant difference between the categories of skills available on the labor market we will use simple ANOVA. This statistical method involves analyzing the dispersion of the penetration rate for each skill group.

Results and discussion

The rapid evolution of technologies and the changing demand on the labor market has determined that public institutions, which have the capacity to issue policies, collaborate with private companies for their common benefit. Thus, World Bank collaborates with the social platform LinkedIn in order to identify the best insights regarding the labor market. 199 economies were selected, and the analysis was performed in the period 2015-2019. Both the top skills required by employers and the penetration rate for each type of skill were measured.

The digital age is not about the title of a job, but about the skills and knowledge that the employee has. Matching a job with a suitable candidate is done at the level of skills. In order for the activities that the job requires to be performed successfully and efficiently, it is necessary for the employee to have certain characteristics that facilitate his activity. Thus, the skills needed on the labor market were classified into five major classes: business skills, disruptive tech skills, soft skills, specialized industry skills and tech skills (Figure no. 1). The World Bank provides us with an evening of data that allows us to observe how the need of the labor market has evolved for the categories of skills required in the digital economy. The data are available for the period 2015-2019, a period in which the labor market did not face major turbulence (Figure no. 1).
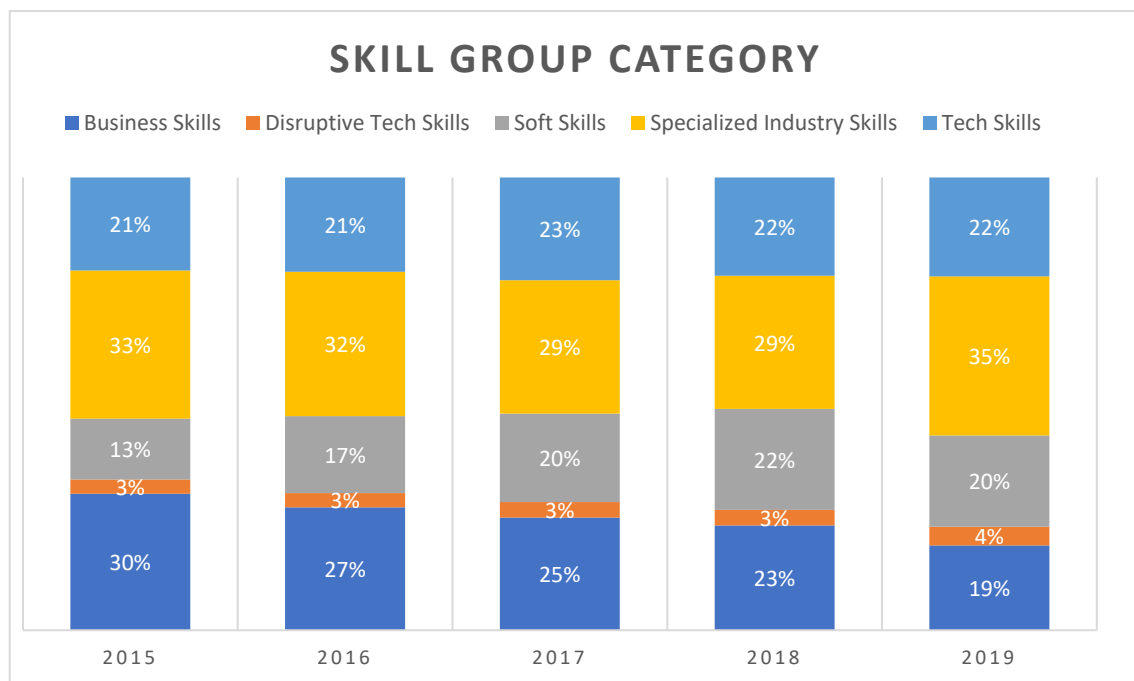

Figure no. 1. The proportion of industries that require a certain skill group category
Source: We used data from https://datacatalog.worldbank.org/dataset/skills-linkedin-data

As we approach the present moment, on the labor market there is an increase in the need for specialized workforce in new technologies, but also for employees with soft skills. Although the skills specialized in each industry mainly occupy the demand of employers, the need for knowledge in new technologies has increased the most in the last 5 years.
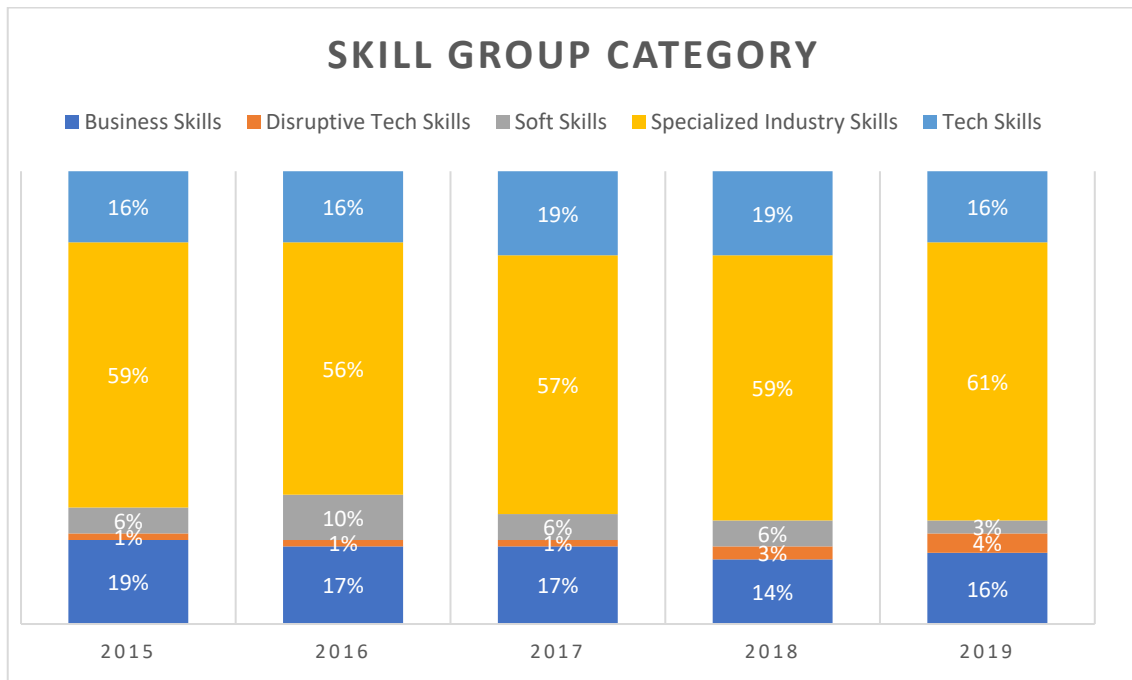
Figure no. 2. The proportion of industries that require a certain skill group category as first option
Source: We used data from https://datacatalog.worldbank.org/dataset/skills-linkedin-data

As previously mentioned, in each field of activity was established a ranking of the main skills needed. It is observed that in each industry, the first required skills are those represented in the previous graph (Figure no. 2). Here we notice how disruptive tech skills strengthen their position on the labor market, even if more than half of the requirements relate to the specific knowledge of each field of activity. However, the accelerated growth rate for futuristic technologies indicates an increased potential for growth in the future.

Table no. 1. The structure of the labor market need for certain skills, by industries in 2015

2015	Arts, entertainment and recreation	Financial and insurance activities	Information and communication	Manufacturing	Mining and quarrying	Professional scientific and technical activities
Business Skills	9%	72%	23%	36%	30%	30%
Disruptive Tech Skills	0%	0%	8%	4%	0%	2%
Soft Skills	11%	20%	11%	16%	20%	13%
Specialized Industry Skills	59%	0%	20%	34%	40%	38%
Tech Skills	21%	8%	39%	11%	10%	17%

Source: We used data from https://datacatalog.worldbank.org/dataset/skills-linkedin-data

Table no. 2. The structure of the labor market need for certain skills, by industries in 2019

2019	Arts, entertainment and recreation	Financial and insurance activities	Information and communication	Manufacturing	Mining and quarrying	Professional scientific and technical activities
Business Skills	3%	53%	11%	20%	25%	21%
Disruptive Tech Skills	0%	5%	9%	2%	0%	4%
Soft Skills	18%	28%	13%	24%	30%	21%
Specialized Industry Skills	55%	5%	28%	40%	35%	36%
Tech Skills	24%	8%	39%	14%	10%	18%

Source: We used data from https://datacatalog.worldbank.org/dataset/skills-linkedin-data

We note that in 2019 (Table no. 2), compared to 2015 (Table no.1), the demand for business skills registered massive decreases in all the analyzed industries. Also, the demand for specialized skills decreased in the industries: Arts, entertainment and recreation; Mining and quarrying; Professional scientific and technical activities. The demand on the labor market for soft skills, tech skills and disruptive tech skills increased significantly in 2015-2019. If we look more closely at each industrial sector, we will see how the share of needs in them has fluctuated.

In 2015, in the Arts, entertainment and recreation industry the most wanted skills were Specialized Industry Skills, in proportion of 59%. Along with these, but to a lesser extent, Technical skills (21%), soft skills (11%) and business skills (9%) were also wanted (Table no. 1). In 2019, the importance of soft skills increased to 18%, but also of technical skills to 24%, the share of the other two decreasing (Table no. 2).

For example, in the Financial and insurance activities industry, in 2015 the need for Business skills was 72% (Table no. 1), and in 2019 it will drop dramatically to 53% (Table no. 2). Thus, the importance of soft skills increases by 8 percentage points. Moreover, within this industry the need for disruptive technical skills and specialized industry skills was noted.

The field of Information and communication is notable for extreme changes in the demand for skills. In this industry are sought specialists with skills developed in this industry, technical knowledge, and business skills is reduced by up to 12 percentage points.

In Manufacturing and Mining and quarrying, the need for human resources with business skills shifts to the need for people specialized in these industries, with technical skills and soft skills. In contrast, Professional scientific and technical activities, which in 2015 showed approximately similar needs, stressed the need for specialists in new technologies.
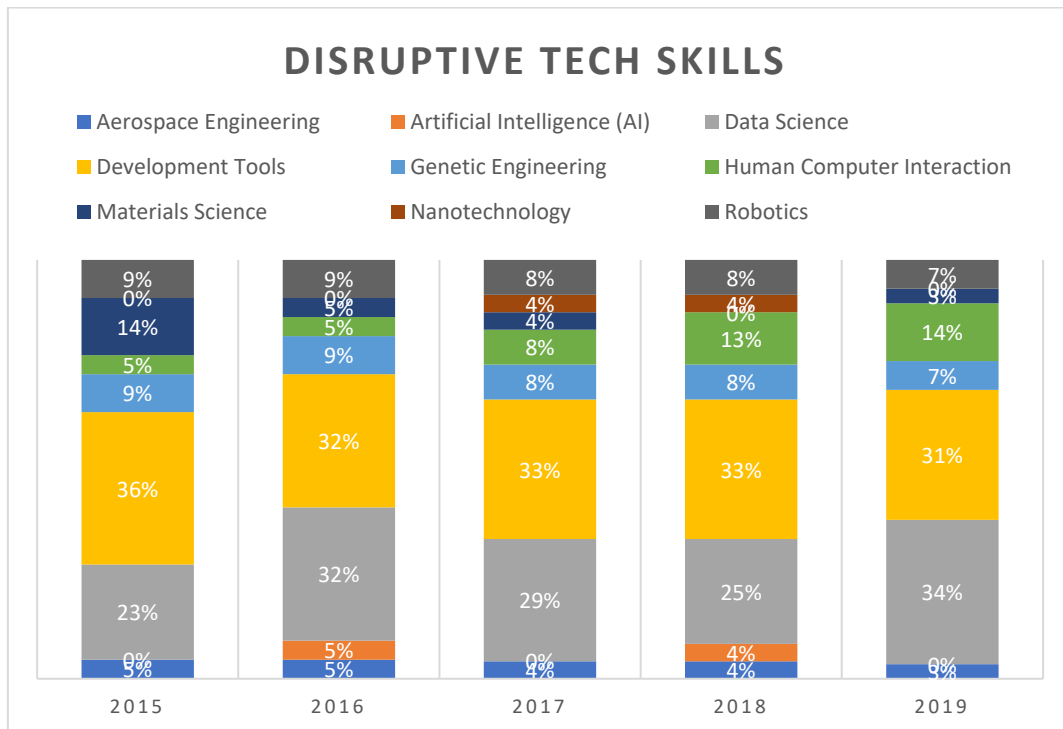
Figure no. 3. The proportion of industries that require a certain disruptive tech skill group category

Source: We used data from https://datacatalog.worldbank.org/dataset/skills-linkedin-data

Among the most wanted knowledge required for the use of futuristic technologies are Data science, Artificial Intelligence, Human Computer Interaction or Robotics (Figure no. 3). This would be the need for the European labor market in a context of continuous evolution. If we look at the supply of specialized human resources, we notice that in 2015 the supply was higher than the demand (Figure no. 3, Figure no.5). As we get closer to the present moment, the situation becomes equal. This makes us wonder if the needs will evolve exponentially compared to the capacity of the educational system to prepare the workforce.

Looking at the problem from the perspective of the availability of skills on the labor market and here we notice a difference between the main categories of skills. By analyzing the top 30 skills needed in each industry, World Bank in partnership with LinkedIn calculated a penetration rate based on TD-IDF statistics. This indicator shows the importance of each job skill posted on the LinkedIn social platform. In 2019, the order of average importance in the skills labor market was Tech Skills, Soft Skills, Disruptive Tech Skills, Business Skills and Specialized Industry Skills. The average penetration rate for each category differs significantly ($ANOVA$: $F_{calc} = 34,16 > F_{crit} = 2,37$). The novelty on the labor market is represented by these futuristic technical skills, which lay the foundations of the industrial revolution 5.0 and which are not easy to develop on the current infrastructure.
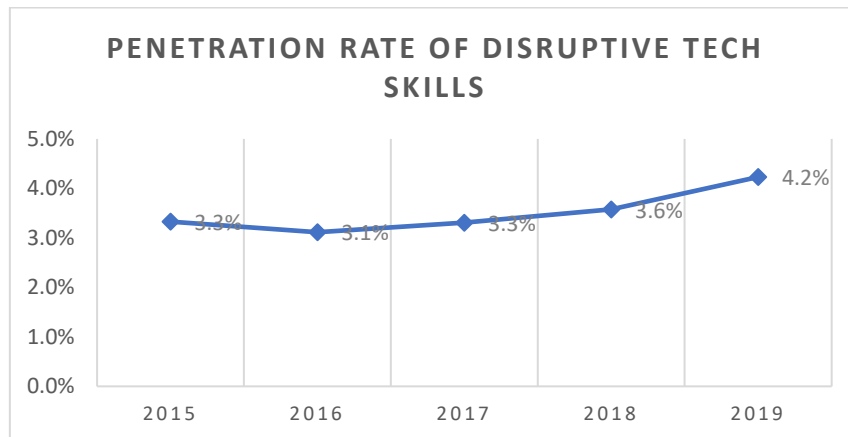
PENETRATION RATE OF DISRUPTIVE TECH SKILLS

Figure no. 4. The evolution of penetration rate of disruptive tech skills
Source: We used data from https://datacatalog.worldbank.org/dataset/skills-linkedin-data

The penetration rate for futuristic technologies has increased in five years by about one percentage point. Their importance on the labor market exists, but it is quite low at the moment (Figure no. 4).
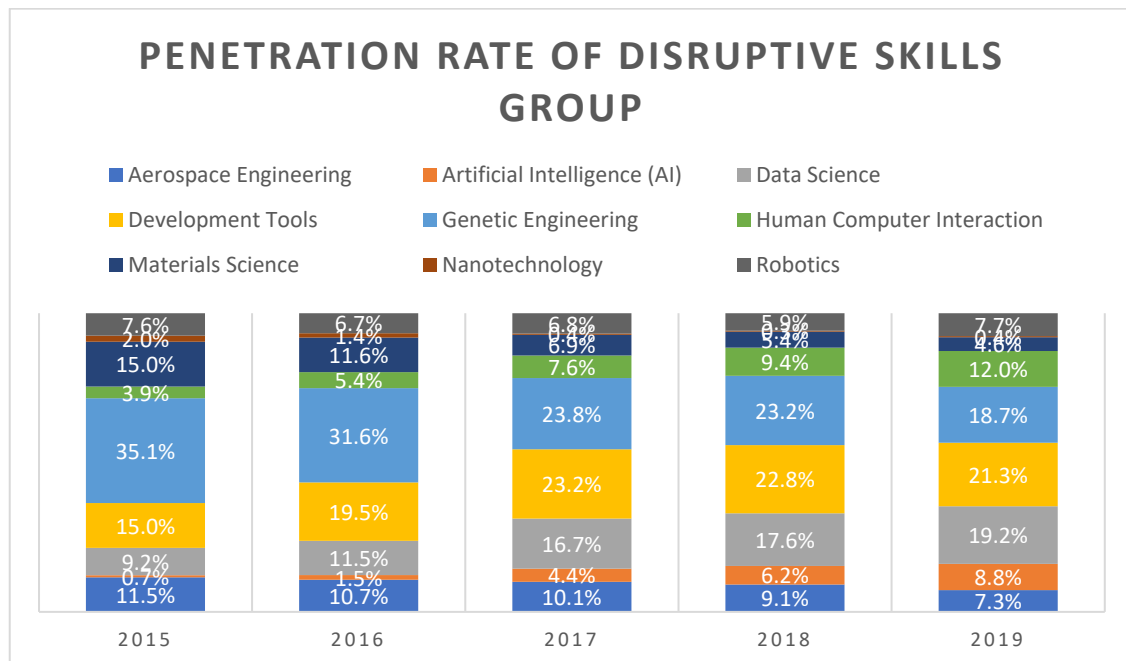
PENETRATION RATE OF DISRUPTIVE SKILLS GROUP

Figure no. 5. The evolution of penetration rate of disruptive tech skills by component category
Source: We used data from https://datacatalog.worldbank.org/dataset/skills-linkedin-data

Most of the candidates on LinkedIn were those with knowledge of using development tools, but also with knowledge in the field of data science. The penetration rate for Development Tools specialists increased from 2015 to 2019 by approximately 6.3 percentage points (Figure no. 5). Also, the demand for knowledge in the field of Data Science increased by 10 percentage points from 2015 to 2019 (Figure no. 5). A spectacular increase is observed in the case of specialists in Artificial Intelligence, which in 2015 almost did not exist on the labor market (Figure no. 5). Nanotechnology is modestly represented on the labor market, both as demand and supply (Figure no. 5). The penetration rate for specialists in the field of genetic engineering and aerospace engineering has decreased, although demand has remained constant over the years (Figure no.5). In the field of Human Computer Interaction and in the field of Robotics we notice an ascending trend of the share of specialists (Figure no. 5). The field that seems to be no longer wanted and for which specialists are no longer in large numbers is the field of

Materials Science (Figure no. 5). Although employers need specialists in Artificial Intelligence, Data Science and Human Computer Interaction, supply is much lower than demand.

Conclusions

The hypothesis from which we started can be confirmed, if we notice that there are a number of new activities closely correlated with technological developments. Practically some of them did not exist at all a short time ago. From this point of view, we can support the creative character that technology has on the labor market. Here arises the need for certain knowledge, which the human resource available on the market does not have very well defined. Demand is slightly higher than supply for jobs that require futuristic technical skills. This creates a certain imbalance in the labor market, which could deepen social differences.

We also argue that technology has changed the way we work in all industries, more or less. Thus, the needs of employers gradually began to change from one year to another. The research highlighted the dynamics of demand in the labor market in terms of skills needs specific to each industry analyzed. We have shown that the need for employees with soft skills and technical skills is growing exponentially. I also noticed how the need for niche and business knowledge are no longer as sought after. It seems that supply and demand have a similar trend of evolution, but we do not know what is the delay with which supply honors demand.

The biggest challenge is to identify areas and industries where the market has become oversaturated and redirect the surplus to other branches where human resources are needed. An oversaturation of the labor market is a negative aspect for the active population, which can risk a reduction in income. It would be beneficial for a system through which the educational offer for each field of activity varies according to the market requirements. In this way the market can meet the demand of employers in a reasonable time.

References

Acemoglu, D. and Restrepo, P., 2020. Robots and Jobs: Evidence from US Labor Markets. *Journal of Political Economy*, 128(6), pp.2188-2244

Balsmeier, B. and Woerter, M., 2019. Is this time different? How digitalization influences job creation and destruction. *Research Policy,* 48(8), Article number: 103765.

Block, K., 2018. *New technologies must create jobs, not destroy them.* [online] Available at: <https://www.weforum.org/agenda/2018/03/new-technologies-must-create-jobs-not-destroy-them/> [Accessed 10 February 2021].

Ford, M., 2015. *The rise of the robots. Technology and the Threat of Mass Unemployment.* New York: Oneworld Publications.

Frey, C.B. and Osborne, M.A., 2017. The future of employment: How susceptible are jobs to computerisation? *Technological Forecasting and Social Change,* 114, pp.254-280.

Handson, R., 2015. *How to Survive a Robot Uprising,* [online] Available at: <https://reason.com/2015/03/03/how-to-survive-a-robot-uprisin/> [Accessed 10 February 2021].

Kattan, R.B., Macdonald, K. and Patrinos, H.A., 2021. The Role of Education in Mitigating Automation's Effect on Wage Inequality. *Labour-England*, 31(1), pp.79-104.

LinkedIn, 2021. *Skills / LinkedIn Data,* [online] Available at: <https://datacatalog.worldbank.org/dataset/skills-linkedin-data> [Accessed 10 February 2021].

Maarten, G. and Manning, A., 2007. Lousy and Lovely Jobs: The Rising Polarization of Work in Britain. *The Review of Economics and Statistics*, 89, pp. 118-133

Peetz, D., 2019. Digitalisation and the jobs of the future. În: The Realities and Futures of Work. s.l.:ANU Press, pp.83-112.

Tohănean, D., Buzatu, A.I., Baba, C.A. and Georgescu, B., 2020. Business Model Innovation Through the Use of Digital Technologies: Managing Risks and Creating Sustainability. *Amfiteatru Economic*, 22(55), pp. 758-774.

World Economic Forum, 2020. *Jobs of Tomorrow. Mapping Opportunity in the New Economy.* s.l.: World Economic Forum.

World Economic Forum, 2020. *The Future of Jobs,* s.l.: World Economic Forum.