Technological Development, Changes on Labor Markets, and Demand for Skills

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This special issue of the journal is dedicated to the role of skills and competencies play in coping with various challenges that labor markets face nowadays. These challenges are triggered by the current wave of technological change driven by new digital technologies, such as artificial intelligence, machine learning algorithms, cloud computing, and dexterous robotics. Although the impact of technological change on labor markets is not a new phenomenon and has been studied extensively over the past several decades, we do not know much about the effects of new digital technologies, which seem to outperform humans in many areas that have until recently been considered as "human terrain" [*Brynjolfsson, McAfee,* 2014]. These rapid developments significantly affect the demand for workers, who possess specific capabilities by changing their work content. They also create new forms of work, for instance, by enabling people to work remotely, by promoting collaboration in digital spaces, and by creating new opportunities for individual entrepreneurship and innovation activities. Thus, this special issue aims at shedding more light on different ways in which current technological progress affects the way we work while focusing on the role of skills. Moreover, it aims at better understanding the multi-dimensional nature of the impacts of the digital revolution by focusing at the level of individuals, organizations, and regions. Finally, it aims at identifying challenges for policymakers and education practitioners who aim at developing various measures to successfully cope with the challenges induced by the current technological change.

The special issue is organized as follows. The first section includes articles dedicated to new developments on the labor markets that affect individual workers, such as the effects of digitalization on occupations and demand for skills as well as the emergence of new forms of work. The papers in this section discuss worker skills that become more valuable in the light of these new trends on the labor markets. The second section of the special issue is dedicated to the regional adaptation strategies by emphasizing the role of regional knowledge and skills pool, for instance, for the emergence of start-ups in the digital sector and for managing the risks of susceptibility of regional workforce to digitalization. Last but not least, the third section deals with the educational implications of the current technological change by discussing promising educational practices aimed at developing competencies required in the 21st century.

Digitalization is undoubtedly one of the key challenges for current labor markets. The paper by Frank Fossen and Alina Sorgner entitled "Mapping the Future of Occupations: Transformative and Destructive Effects of New Digital Technologies on Jobs" opens the first section of the special issue by proposing a multi-dimensional approach to conceptualize the impact of digitalization on occupations. On the one hand, destructive digitalization substitutes human labor. On the other hand, transformative digitalization changes the content of jobs and complements human labor. It is argued in the paper that although transformative and destructive digitalization can affect occupations in distinct ways, occupations differ only *gradually* with regard to the impacts of digitalization on them. Based on representative data on occupation-specific characteristics in the U.S. (O*Net database), the authors demonstrate that a large share of occupations either face a very strong transformative and at the same time a very low destructive digitalization, or vice versa. Thus, new digital technologies have strong potential to change or to replace a vast number of occupations. The key competences will likely be the ability to cope with the

transformation of one's occupational environment and to adapt to these changes by means of acquiring capabilities that can be defined as automation bottlenecks, such as originality, social perceptiveness, negotiation, and persuasion. The study concludes with a discussion of the implications of the proposed multi-dimensional approach to conceptualize the impacts of digitalization on jobs for policymakers attempting to design programs to mitigate the destructive effects of digitalization and better exploit the opportunities that arise from its transformative impacts.

The next paper in this section was co-authored by Yaroslav Kuzminov, Pavel Sorokin, and Isak Frumin and entitled "Generic and Specific Skills as Components of Human Capital: New Challenges for Education Theory and Practice" offers an overview of the discussions concerning how the concept of human capital has evolved over the previous decades, thereby emphasizing the limitations of the traditional approach based on measuring the formal level of education in explaining, for instance, the slowdown of economic growth in several countries. The new reality of the 21st century poses a serious challenge not only to the theory of human capital, but it also calls for significant adjustments in existing educational systems and for a revision of educational policies. These should account for the rapidly changing demand in worker skills around the globe and the increasing relevance of types of human capital that go far beyond the formal education, such as creativity, critical thinking, lifelong learning, non-cognitive skills, and human agency. Particularly human agency or the ability of individuals to be self-organizing and pro-active appears to gain in importance in the coming decades not only for entrepreneurs but also for dependently employed workers.

An in-depth analysis of the digital transformation of occupations in the financial sector is provided in the paper "Twenty-First Century Skills in Finance: Prospects for a Profound Job Transformation" by Natalya Shmatko and Alina Lavrinenko. Based on a comprehensive analysis of job advertisements posted on major online recruiting platforms and expert interviews, the authors were able to determine the key competences that employers in the banking sector are looking for when recruiting employees. The demand is particularly high for advanced digital skills, including applied computer programming, Big Data analytics, and the use of specialized software. Moreover, employers are increasingly looking for universally applicable competences or "soft" skills in the potential candidates, such as strong interpersonal skills and stress tolerance. In further analysis, it is shown that although occupations in the banking sector are differently affected by digitalization, many of those occupations are facing strong transformative digitalization, which has the potential to change the spectrum of tasks human workers will perform in these occupations in the future. This development suggests that another key competence of employees in the banking sector will be the ability to deal with uncertainty and to adapt in a timely to the rapidly changing tasks in their occupations.

Technological progress is also conducive to the emergence of new forms of the organization of work. Ina Krause's paper entitled "Coworking Space: A Look into the Future of Work" deals with the question of how the organization of work has evolved over time. The author reviews the history of modern forms of work, thereby distinguishing between three major periods: Fordism (postwar industrial period), Toyotism (diversified-quality production systems), and Uberism (shared and virtual economy). Each period is characterized by distinct ways of organizing the working process, different skill requirements, and work attitudes of individuals. Earlier periods were characterized by a strong focus on production work with non-flexible working times and a high demand for manual skills (during the Fordism period) and, subsequently, project-based type of management with a strong demand for technical skills and more flexible working times (during the Toyotism period). In contrast to the earlier periods, the current Uberism period relies on cooperative management of knowledge work. It requires more "soft" skills, such as interpersonal, intercultural, and self-promotion skills, and it relies on the virtual working context as an important development that has become possible due to digital technologies. One implication of this development is that the concept of work loses its organizational and local embeddedness and it influences individuals' identities even stronger than in the former periods. This has implications with regard to the need to revise the current concept of work and to develop strategies that allow for embedding it into an appropriate institutional setting.

The second section of the special issue is dedicated to the regional adaptation strategies to challenges related to current technological change. The papers in this section investigate the role of regional knowledge and regional skill endowments that will help regions adapt to digital transformation. The paper by Michael Fritsch and Michael Wyrwich entitled "The Role of Knowledge, Skills, and Opportunities in the Emergence of Information Technology Start-ups" investigates the regional emergence of new businesses in information technologies (IT) in Germany. The share of firms in the IT sector can be expected to grow in the near future, thereby positively contributing to regional employment growth. Firms in the IT sector may also be important for the regional economy in indirect ways, for instance, by producing IT knowledge and IT skills that are likely to be in high demand in the future. The authors report strong differences in the regional distribution of start-up activities in the IT sector in Germany. The main factors for these differences are the regional employment share in IT services and the presence of higher education institutions (HEIs) with education and research in computer science. These re-

sults suggest that rural regions and regions that lack HEIs and human capital relevant to the IT sector may experience shortage of IT-start-up activity in the foreseeable future.

Another spatial aspect of the current digital transformation, namely the relationship between Industry 4.0 and clusters, is discussed in the essay "The Industry 4.0 Induced Agility and New Skills in Clusters" by Marta Götz. The author attempts to link the existing literature on clusters that does not sufficiently account for the most recent digital transformation with the well-established literature on Industry 4.0. Although the paper is of a speculative nature, it nevertheless draws attention to the potential ways in which digital transformation affects clusters and particularly firm agility by enforcing their adaptability and by developing the skills of the cluster workforce.

Stepan Zemtsov, Vera Barinova and Rosa Semenova in their paper entitled "The Risks of Digitalization and Adaptation of Regional Labor Markets in Russia" investigate the differences in the susceptibility of regions to the automation of labor in the case of Russia. The authors identify several regional factors that are favorable for successfully dealing with this challenge, among which one can mention the presence of agglomerations with a high concentration of diversified human capital, well-developed IT infrastructure, favorable regional conditions for entrepreneurial activities, and high innovation potential. Many regions facing high risk of automation currently lack these assets, which makes them more vulnerable in the long-run. The authors also formulate recommendations for regional policymakers who attempt to design regional development policies by means of digital technologies. Such policies will need to account for the specifics and variety of regional adaptation strategies.

Technological progress poses a major challenge to existing education systems, putting established education programs increasingly at risk of failing to meet labor market demand for new competencies. The third and the final section of the special issue is dedicated to the discussion of selected educational practices that might be useful for successfully coping with the changing demand for skills. Hillary Swanson and Allan Collins in their paper "Learning to Theorize in a Complex and Changing World" describe an innovative course, which was implemented at a public middle school in the U.S. with the aim of developing students' "soft" skills, such as abstract and critical thinking, by means of using methods of scientific theory building. Such skills, if successfully developed, will prepare the students to make decisions in increasingly uncertain and complex environments.

Last but not least, Dzamilya Abuzyarova and colleagues in their paper entitled "The Role of Human Capital in Science, Technology and Innovation" attempt to shed more light on the educational needs of the future workforce by analyzing the HSE alumni's evaluation of competencies acquired during their higher education. While the theoretical, "hard" skills acquired at the university are clearly the most valued in former students' evaluations, the analysis also reveals that new forms of extracurricular education, such as e-education (MOOC) and emotional intelligence development training, are becoming increasingly important, thus, indicating that life-long extracurricular learning will become crucial for acquiring the key competencies in the 21st century.

References

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