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Franciszek Kutrzeba | fkutrzeba@zie.pg.gda.pl
Gdansk University of Technology, Department of Management and Economics

Future Skills and Education in a Computerized World

Abstract: As computerization of Western economies has advanced, the supply of the demand for routine cognitive tasks and routine manual tasks has fallen. Computerization has increased labour input of nonroutine cognitive tasks which has favourized high educated workers. Similarly, there is clear evidence of an increase in demand for high skilled workforce which originates from poor machine performance of nonroutine manual tasks. Given the latest technological development, such skills as critical thinking, complex cognitive skills and novel ideation are those areas where people still outperform computers today. In Poland, a decline in demand for tertiary education has been observed during the recent years notwithstanding good returns to investment in education that are the highest among the OECD countries. The question is, what should the role of tertiary education be in the automatized world? How to develop or educate those skills in which people excel computers given mass education? The purpose of this article is to highlight demand for future skills in regard to actual technological changes and to present chosen macroeconomic data that characterizes the situation of tertiary education with a focus on Poland. Finally, a suggestion for further research is presented.
Key words: future skills, higher education, technical change, computerization, meta-skills, human labour

Higher education

Universities experienced an exceptional enrollment boom in the OECD countries in the 1990's where students had abandoned vocational education for the sake of an academic one [OECD 2016]. In Poland, the number of students grew by almost 500% from 404,000 in 1990 to over 1,950,000 in 2005 but has been on decline ever since and was 1,405,133 in the end of 2015 (GUS, 2016). Education has a clear and significant positive effect on wages [Santos, Sequeira, 2013] but qualifications are more valued than skills [OECD 2016]. According to the authors of "Communication from the commission –

Europe 2020", better educational levels positively affect employability and increased employment rate facilitates reduction of poverty [Europe 2020]. Nevertheless, literature on returns on investment in education suggest that macroeconomic evidence of returns on schooling are limited [Temple 2002, Psacharopoulos, Patrinos 2010].

Universities and other institutions offering high education are facing a need to justify their existence. The returns to schooling are declining, especially in the United States. The costs of higher education is increasing faster than inflation while the value of a university degree is falling [Barber, Donnelly, Rizvi 2013]. The returns are lower in the high income OECD countries and lowest for the non OECD European, Middle East and North African group of countries [Psacharopoulos, Patrinos 2010]. The Polish higher education institutions, both private and public, are competing for students as there is a significant decline in demand for tertiary education that is in turn partially due to declining demographics [Sojkin, Bartkowiak, Skuza 2011]. The number of 19-year old people in Poland will be 48% lower in 2020 than in the year 2002, and 32% less than in 2010 [Antonowicz, Krawczyk-Radwan, Walczak 2014]

In response to urgent demographic issues and challenges of globalization and financial crisis, the European Commission had set a series of objectives that should be reached for achieving smart and sustainable economic growth. As means to protect European societies against the risk of poverty, three of these targets point at better use of human resources. Special attention has been addressed on improving employment, skills and labour through education. Furthermore, at least 40% of the younger generation should have a tertiary degree [Europe 2020]. It is noteworthy to mention, that holding a university diploma does not guarantee its holder to be educated [Sulkowski, Zawadzki 2016].

Polish higher education institutions (HEIs) have become customer-oriented; educational services are treated as sellable products and their price has become a tool of competition. Traditionally the core value of an HEI was its reputation for the quality of education offered [Buczak 2016], Antonowicz, Krawczyk-Radwan, Walczak [2014] argue that branding, although a little different than reputation, in HE is a relatively new phenomena although universities have emphasized their distinctiveness and uniqueness throughout centuries [Antonowicz, Krawczyk-Radwan, Walczak 2014].

The number of unemployed graduates has increased recently and there has been a significant decline in demand on higher education in Poland. According to official data, the registered unemployment rate among people with tertiary education in Poland was 4,1% in 2014. Low unemployment levels for high educated people might be caused by occupational migration. In 2012, ca 2,5 millions of Poles lived in the EU-15 nonetheless there is no data regarding their educational levels [Duszczyk, Matuszczyk 2015]. Buczak [2016] suggests that one reason for declined demand on HE is digitalization of information and

hence because of a better accessibility to scientific studies and discoveries [Buczak 2016]. Stiglitz [2004] notices that technological development induces fundamental changes in societies that include abandoning traditional ways of thinking, altering attitudes and preferences. New technologies replace traditional jobs but also create new ones; according to some estimates, one high-tech job creates five new jobs in other sectors. Parviainen et al. [2017] point out that digitalization produces huge amounts of easily transmittable and freely available information and that this has brought about changes in traditional power structures. Furthermore, new technologies may also increase productivity and alter status quos [Parviainen et al. 2017].

In Poland, the main motivating reason for acquiring education had for many years been higher salaries and for 20% of respondents the reason was employability – desire to avoid unemployment. In 2009, 89% of Poles stated that it is valuable to acquire education. [CBOS 2009 (in:) Kiersztyn 2011] According to a newer study, 57% of respondents considered that a university diploma has a small value on the labour market. Furthermore, respondents believed that technical education provides better chances in terms of employability than a degree in humanities. Opinions regarding the value were determined mostly by respondents' level of education. Those with a HE diploma considered the value of HE degree lower and that the HE is mass produced more frequently than those without a diploma [CBOS 2013]. In Poland, people with a HE diploma have in fact higher earnings than low educated and lower unemployment [GUS 2016]. This quasi-paradox can be explained by unrealistic expectations in regard to future earnings by those who had invested in higher education. Unrealistic expectations can in turn result from information asymmetry; students' misperception of their potential future market value and the quality of labour input demand on the other. Overeducation or competence mismatch are some of the common macroeconomic reasons for dissatisfaction of high educated workers. "Significant proportion of the labour force in developed countries has more education than is actually required for their jobs, i.e. is overqualified" [Budria, Moro-Egido 2014] Temple [2002] suggests that limitations of macroeconomic evidence of how returns to schooling benefits different individuals should involve consideration of wider benefits [Temple 2002]. Such benefits – sometimes called externalities, spillover benefits or social rates of return – are hard to capture both for the educated person, his/her society and economists [Psacharopoulos, Patrinos 2004].

There is a decline in demand for education but the returns to investment in education in Poland are the highest among the OECD countries. Meanwhile, return to skills for Poland is little above the average [OECD 2016]. This observation is supported by Psacharopoulos and Patrinos's [2010] study according to which the returns to education are higher in the low and middle income countries [Psacharopoulos, Patrinos 2010]. It is

worth mentioning that there is tangible and measurable returns to investment in education on a micro level but, as Psacharopoulos and Patrinos suggest, "such evidence is not as consistent and forthcoming in the macro literature" [Psacharopoulos, Patrinos 2010]. They [2010] suggest that more data on the impact of education on earnings should be gathered.

Polish real GDP growth has been robust and was one of the highest among OECD countries in the years 2007–2014. Yet, the share of high technological content in Poland's export as well as productivity levels have stayed weak. Strengthening skills, improving Poland's capacity for innovation and increased investment in research and development are one of the government's objectives [OECD 2016]. Automation should facilitate and improve productivity and it could also help offset the impact of a declining share of the working-age population that many countries are struggling with [Mckinsey 2017]. Autor [2015b] notes that tasks that cannot be substituted by automation are often complemented as most work processes comprise multifaceted set of inputs e.g. creativity and rote repetition or technical mastery and intuitive judgement. Complementation of work processes occur typically in the routine cognitive and routine manual tasks hence increasing the economic value of remaining tasks [Autor 2015b].

Future skills

Automation and digitalization bring about fundamental changes in everyday life and professional practice. Robots outperform humans in some cognitive tasks and most physical activities. They can be trained to perform numerous cognitive tasks but they still remain limited [McKinsey 2017]. Computers are better at resolving most of the tasks that require only the skills of the three Rs – writing, reading and arithmetic. Complex cognitive skills enable people to learn miscellaneous skills and is one of the significant differences between people and machines. Brynjolfsson and McAfee argue that valuable knowledge workers can maintain their competitive advantage over machines only by improving "the skills of ideation, large-frame pattern recognition, and complex communication instead of just the three Rs" [Brynjolfsson, McAfee 2014, p. 90]

Computerization substitutes better for those tasks that are routine based rather than nonroutine because they are easily codifiable and characterized with high predictability. Increase in computer capital reduces labour input of routine cognitive and manual tasks but increases labour input of nonroutine cognitive tasks. This in turn has led to favourizing educated workers; people that are able to solve tasks that are characterized by high unpredictability and require complex and nonroutine cognitive abilities such as creativity, critical thinking or complex communication [Autor, Levy, Murnane 2003,

Autor 2015b]. The author shares the idea of Kuhn [1999], Perry [1970] and Golding [2011] among others according to which critical thinking is not about swapping opinions but reasoning in a constructive manner that comprises evaluation of reasoned judgements in a sophisticated epistemic manner [Golding 2011]. For Kuhn "critical thinking by definition involves reflecting on what is known and how that knowledge is justified" [Kuhn 1999, p. 23]. Sulkowski and Zawadzki [2016] advocate the idea of higher education as a sphere where young people could critically think of the knowledge they gain. They [Sulkowski and Zawadzki] note that individuals that lack abilities of critical thinking turn to become mere alienated and disengaged consumers which in turn fosters cynicism [Sulkowski, Zawadzki 2016].

Acemoglu and Autor [2011] suggest a two-by-two matrix where work is divided into cognitive versus manual and routine versus nonroutine work. They found that a nonroutine manual (eg. hairdressing) and cognitive (eg. financial analysis) are still on demand while a dramatic decrease in demand for routine tasks, whether cognitive or manual, is observable. Basing on Acemoglu´s and Autor´s work, Jaimovich and Siu [2012] found out that between 2001 and 2011 the "routine cognitive tasks such as cashiers, mail clerks, and bank tellers and routine manual tasks such as machine operators, cement masons, and dressmaker" [Brynjolfsson, McAfee 2014, p. 66] plummeted by 11% and it was the third *decade* in a row of decrease. In the contrary, the nonroutine cognitive and manual jobs had increased during that same period [Brynjolfsson, McAfee 2014, p. 66]. Autor [2015a] notes that the possibility of replacement of human employment by computers is exaggerated and that the human intuition and the value of interaction of human labour, human judgement and automation is often underestimated in productivity growth measurements [Autor 2015a, in: Parviainen et al. 2017]

On the other hand, computers are inferior in creating new *good* ideas and complex communication. They are specialized in one or few tasks at a time only while a single human being can be specialized eg. in journalism, photography, gardening and cooking simultaneously; people can conduct multiple and highly differentiated tasks and robots require deprogramming depending on the task [Brynjolfsson, McAfee 2014]. Humans still excel in generating novel patterns, logical reasoning, creativity, coordination between multiple agents, communication in natural language, emotional intelligence, and moving around in diverse environments [McKinsey 2017]. Good communication skills not only provide human labour with competitive advantage over machines but they also constitute a source of job satisfaction for workers and their service receivers [Maguire, Pitceathly 2002].

According to The Future of Jobs Report the top three skills that will be on demand in 2020 are complex problem solving, critical thinking and creativity. The further three are closely related to social interaction – people management, coordinating with others and

emotional intelligence [World Economic Forum 2016] which all are crucial for knowledge creation – skills that are realized on the basis of acquired knowledge which is created through cognitive experience but enabled or limited by genetic preconditioning[1]. Some theorists argue that knowledge-creation starts from socialization [eg. Nonaka, Toyoma 2003] which in turn – according to the idea of Piaget – entails the learning of cognitive, personal, and social skills that allow people to function appropriately in their communities [Piaget 1929, 1965, in: Gould, Howson 2015]. Similarly, Wenger et al. argue that social interaction generates knowledge and facilitates knowledge sharing and learning [Wenger et al. 2002]. According to human capital theory, higher stock of knowledge provides individuals with a higher cognitive ability [Almendarez 2013]. Furthermore, individuals with a stock of knowledge of higher quality or more knowledge are also better at perceiving and taking advantage of entrepreneurial opportunities than those with less human capital [Davidson, Honig 2003, in: Block, Sandner 2009].

The trend in the US labour market has been as follows: nonroutine cognitive work and nonroutine manual work had been growing for three decades from at least 1980's to 2000's. Meanwhile, as the computerization of the economy was advancing, the supply of the demand for routine cognitive tasks and routine manual tasks was acceleratingly falling [Brynjolfsson, McAfee 2014]. Computerization has increased labour input of nonroutine cognitive tasks which has led to favourizing educated workers; there has been a relative demand shift favouring college labour during 1970 to 1998 in the US [Autor, Levy, Murnane 2003]. Surprisingly though, newer data and research have discovered "an unexplained deceleration of employment growth in abstract task-intensive occupations after 2000" [Autor 2014, p. 149].

A rise in the supply of skilled labour can increase the relative demand for skilled labour by inducing skill-biased technical change [Behar 2016]. "Skill-biased technical change is a shift in the production technology that favours skilled over unskilled labour by increasing its relative productivity and, therefore, its relative demand" [Violante 2008, p. 1]. Violante notes that recent technological change has been skill-biased while traditionally it was viewed as factor-neutral. The so called factor bias attribute puts technological change at the centre of the income-distribution debate. Theories and data suggest that at least in the adoption phase, new information technologies are complementary with skilled labour. Later on there will be "enough workers learning how to work with the new technology to offset the wage differential" [Violante 2008, p. 5].

[1] As far as the author is concerned, a prerequisite for the functioning of both cognitive (in case of cognitive organisms; epistemic aspect) and biological abilities (biological aspect) is the genetic code (DNA or mRNA sequences) and suggests it to be referred to as genetic knowledge.

Conclusions

Technological development induces organizational changes that favour skilled over unskilled labour. Workers that have general skills and are familiar with multitasking can better adapt to organizational changes and thus benefit from such transformations. Top skills that will be on demand in the future will rely highly on complex cognitive abilities. Furthermore, tasks that require complex problem solving, critical thinking, creativity and complex communication will most probably be still performed by human labour. High skills is one the fundamental premises to gain competitive advantage and to be better off in technological transformations – not low labour costs [Parviainen et al. 2017]. A suggestion for further research is to gather evidence if future skills are being educated and how they are perceived by students in the higher Polish education institutions today. Development of these skills seems to be necessary for the Polish economy to take full advantage of the Fourth Industrial Revolution.

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