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HOW DOES TECHNOLOGY CHANGE THE NATURE OF WORK? POLAND vs. THE EU

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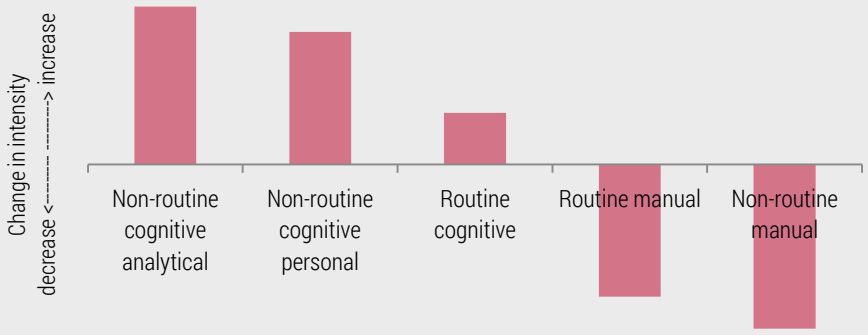
Abstract

Because of technological progress, non-routine cognitive (analytic and interpersonal) tasks are becoming increasingly more important in labour markets across the EU, while manual tasks are in decline. Poland is following this global trend. However, unlike in the more developed EU countries, the importance of routine cognitive tasks is growing in Poland. This is due to the development of the services sector which is dominated by routine cognitive tasks. Deroutinisation and the growing importance of intellectual work worsen the position of workers performing routine and physical tasks: the risk of unemployment in this group is going up and relative wages are falling. The objective of public policy is to prevent polarization caused by technological progress. Education policy has to put a greater emphasis on developing the skills that are necessary to perform non-routine cognitive tasks. Through training courses, social policy should offer help in acquiring new skills to workers displaced by new technologies. It should also use the tax and benefit policies to prevent the widening of income inequality.

Key facts

- 8 pp – increase (from 1998 to 2015) in the employment share of workers who perform mainly non-routine tasks;
- 30% – the share of routine workers in total employment in Poland;
- 57% – the share of routine workers who are not able to use ICT technologies to solve problems at work;
- 37% – the stock of robots per worker in industry in comparison to the figure for the EU15;
- 1.5% – the share of workers employed the business services offshored to Poland.

Poland experiences a transition from manual to cognitive jobs



*Source: own calculations on LFS and O*NET data.*

1. Introduction

Recent technological progress speeds up changes in the nature of work. The tasks that we perform at work have changed, and they require different skills. The consequences of the accelerated changes in the nature of work affect employers, who introduce new technologies, and workers, who have to adapt to the new demands. The effects are also felt by governments whose role is to support the absorption of new technologies, on the one hand, and to mitigate the negative consequences of rapid changes in the labour market, on the other hand. Therefore, it is important to understand how technological progress impacts changes in the nature of work. Hence, this paper has three goals. First of all, to track the changes in nature of work that have recently occurred in Poland, and to compare them with changes in other European Union countries; secondly, to identify the sources of these changes; and thirdly, to examine the challenges that the changes in the nature of work pose for public policy.

In the first two decades of the 21st century, the nature of work across the EU has changed significantly. The importance of non-routine cognitive tasks has clearly increased, primarily with regard to analytical tasks which require the processing and interpretation of data and information, but also interpersonal tasks which require building and maintaining relationships with other people. At the same time, the importance of manual (physical) tasks has fallen sharply. However, what distinguishes Poland from the more developed EU countries is the growing importance of routine cognitive tasks which require structured, repetitive activities. This difference is driven by the increasing employment in services in Poland, including business services, where these tasks prevail.

Education and social policy constitute key responses to the challenges posed by changes in the nature of work. The education system should put more emphasis on the development of skills necessary in order to perform analytical and interpersonal tasks, the demand for which is growing. Priority should be given to those fields of study that help increase the supply of workers in occupations dominated by non-routine cognitive or interpersonal tasks. Social policy should help individuals to find new jobs, e.g. through properly designed training courses for workers who are made redundant as a result of technological changes. Moreover, income redistribution policies should be used to prevent the rise of inequalities and polarization that may result from technological changes.

In the second chapter, we explain how the nature of work is defined and analysed. In the third chapter, we show how it has changed in Poland and other EU countries in the last 15 years, and indicate the sources of these changes. In the fourth chapter, we analyse how the nature of work affects the prospects of workers, especially the risk of unemployment and the level of wages. The final, fifth, chapter presents conclusions for public policy.

2. How we understand the “nature of work”

Every job is made up of a set of tasks that constitute "a unit of work activity that produces output" (Acemoglu, Autor, 2011). Individual occupations differ from each other in terms of the required set of the most important tasks. People need certain skills to perform specific tasks, and workers’ potential in this regard affects their productivity in a particular occupation. The ability to manage more difficult tasks makes it possible to receive a higher income, both on an individual and macroeconomic level. On the other hand, a mismatch between the structure of workers’ skills and the tasks required by employers implies a simultaneous existence of unemployment and vacancies.

Technology can support workers in performing specific tasks and complement their skills, but it can also substitute them in some activities. The typology of occupational tasks proposed by Acemoglu and Autor (2011) is commonly used to capture the links between technology and labour. It distinguishes five types of tasks:

- non-routine cognitive analytical or non-routine cognitive interpersonal tasks that require, respectively, creativity, problem-solving, and data analysis, or extensive communication, building and maintaining interpersonal relationships, directing and supporting other people;
- routine cognitive tasks that require being exact or accurate when performing structured, repetitive intellectual activities;
- routine manual tasks that require the operation of machines and processes, repetitive physical activities, adapting the pace of work to the speed of equipment;
- non-routine manual tasks that require manual dexterity, using hands to feel and control objects or equipment, responding to the environment, spatial orientation.

Until the second half of the twentieth century, technological progress manifested itself mainly in machines that supported or even replaced people in performing physical work and routine manual tasks. However, the development of information and communication technologies (ICT) has made it possible to automate routine cognitive tasks (e.g. through spreadsheets) and to improve the automation of some physical tasks (e.g. through robotisation). At the same time, it has facilitated the performance of non-routine cognitive tasks (e.g. through digital communication tools or computational software) and created many new occupations which essence is to use or develop new technologies. Nonetheless, ICT technologies (so far) do not have a large impact on non-routine manual tasks that require unstructured and changing activities, or reacting to events and people. So far, technology is not as effective with these tasks as with structured jobs.

Table 1. Individual occupational tasks differ in the skills required of workers and the ability to automate their performance

	Non-routine cognitive (analytical and interpersonal)	Routine cognitive	Routine manual	Non-routine manual
Requirements	Abstract thinking, creativity, problem solving, strong communication skills	The implementation of clearly defined and repetitive sequences of cognitive activities, accuracy and being exact	The implementation of clearly defined and repetitive sequences of manual activities, accuracy and being exact	Simple tasks, but requiring situational adaptability, language and visual recognition
Relation with ICT technologies	Computers support the implementation of these tasks and increase the productivity of workers performing them	Easily algorithmized with the help of a computer programme, so the workers performing them can be replaced by technology	They can easily be subject to automation	Difficult to automate (especially at the cost that justifies replacing a human with a machine)
Type of workers	High-skilled workers	Middle-skilled workers	Low- and middle-skilled workers	Low-skilled workers
Occupations in which many such tasks are performed	Specialists, for example, designers, engineers, IT specialists, technicians, managers	Office clerks, sellers, administrative workers, cashiers	Production workers, e.g. machine operators, assemblers and locksmiths	Drivers, miners, construction workers, waiters and waitresses, porters, cooks

Source: own elaboration based on Acemoglu, Autor (2011).

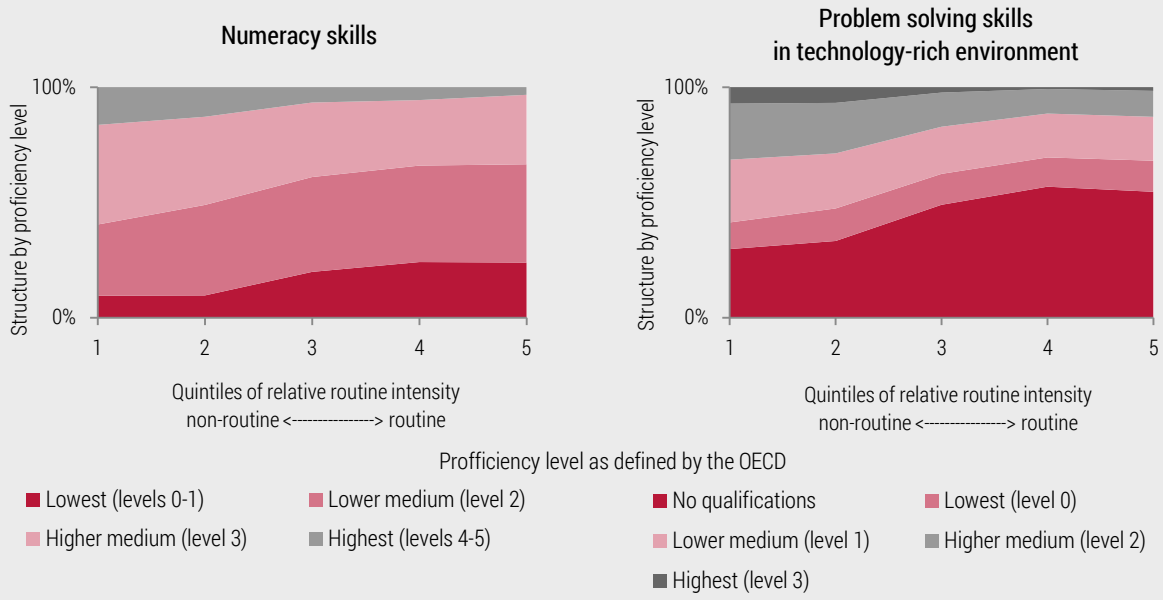
The basic unit in defining task content is occupation. In every occupation, the proportions of individual tasks are slightly different. Table 1 presents the characteristics of individual types of tasks and examples of occupations in which a given type dominates. It is not easy to measure task content, because there are only a few data sources. The main one is the O* NET dataset which provides the detailed descriptions of several thousand occupations. O*NET is being collected in the US but can be applied to European countries as well. Another source is the PIAAC study, conducted by the OECD, which collects data on adult competences and the use of skills at work. In practice, the more non-routine tasks are, the higher level of skills is necessary. The relationships between tasks and skills are explained in Box 1.

Box 1. What are the differences between tasks and skills?

Tasks are not synonymous with skills. Usually, multiple skills are needed to perform a given task, and a given skill can be useful in performing many tasks. However, if a certain skill can be used only in a narrow and similar set of tasks, the emergence of a technology that is capable of replacing people in these tasks can make this skill useless on the labour market. Workers who lack other skills which are useful for performing other tasks that machines do not manage so well (or manage at a much higher cost), will then face the risk of technological unemployment.

Performing non-routine tasks, in particular the cognitive ones, requires more advanced skills than performing routine tasks. This is illustrated in Figure 1, based on the PIAAC survey data, which is the only current, representative and internationally comparable survey of adult skills that includes Poland. PIAAC measures the numeracy and literacy skills, as well as problem solving skills in technology-rich environment. For each of these skills, there are differences between the proficiency level of people performing more or less routine-intensive work: the more routine-intensive job, the lower the share of high-skilled people and the higher the share of low- skilled workers (this also applies to literacy skills, not included in the figure below). Because automation replaces workers primarily in the area of routine tasks, technological progress reduces the demand for work primarily for people with low or medium skills. It is also worth mentioning that the share of workers with low ICT skills in Poland is visibly higher than the OECD average, also among people performing relatively non-routine jobs.

Figure 1. Routine jobs are performed by people with lower skills



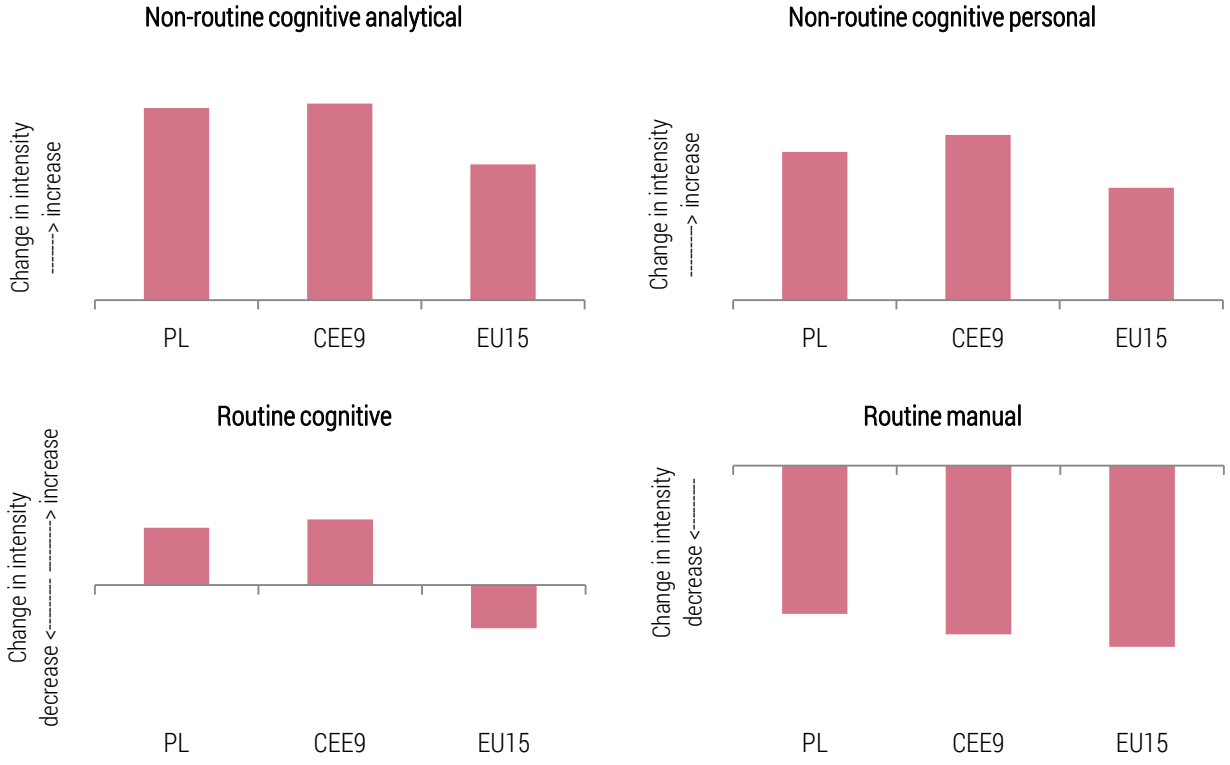
Note: The figures present data for Poland.
*Source: own calculations based on O*NET and PIAAC data.*

3. Changes in the nature of work and their sources

In Poland, a gradual transition from manual to cognitive work is taking place, especially concerning non-routine tasks. In the most developed countries, this process has been visible since the 1970s. In the 1990s it started to gain momentum and has become a global phenomenon. The importance of non-routine cognitive tasks that require high qualifications is growing across Europe, including in Poland, while the importance of manual tasks that require a relatively low level of skills is decreasing (Figure 2). The percentage of workers who mainly perform non-routine cognitive tasks has increased in Poland from 26% in 1998 to 34% in 2015.

The importance of routine cognitive tasks is also growing in Poland. A similar situation can be observed in other countries of our region. This distinguishes Central and Eastern European countries from Western European countries, where the role of routine cognitive tasks is decreasing. Routine workers constitute approx.1/3 of all the employed in Poland (Keister, Lewandowski, 2017). A large sub-group of the routine workers is employed in occupations that require a lot of routine manual and routine cognitive tasks. These are mainly men with basic vocational or secondary education, most often working in industry. The second subgroup consists of workers employed in occupations that require mainly routine cognitive tasks – the majority of them are secondary educated women who work in services. Moreover, PIAAC data shows that compared to Western European countries, Poland and other CEE countries not only have a higher employment in relatively routine occupations, but also exhibit a higher routine content within the same occupations, including high-skilled occupations, such as managers, technicians, and specialists (Hardy et al., 2018b).

Figure 2. In Europe, the importance of non-routine cognitive tasks is growing and that of manual tasks is decreasing, but Poland and other countries in the region differ from Western Europe with a growing importance of routine cognitive tasks



Note: Change in the importance of individual tasks between the years 1998–2000 and 2013–2015. CEE9: Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia. Bulgaria is omitted due to data issues.
*Source: own calculations on EU- LFS and O*NET data.*

The factors behind changes in the nature of work, in particular behind the declining importance of routine tasks and the growing importance of non-routine tasks, are connected to technological progress and globalization.

Computers and robots are replacing people primarily in the performance of structured and repetitive tasks that can be described by algorithms, in other words, in routine tasks (Brynjolfsson, McAfee, 2014). In the most developed countries, since the 1970s, computerization has led to both a decline in the most routine-intensive occupations and a decline in the importance of routine tasks in individual jobs (Autor et al., 2003, Spitz-Oener, 2006). The development of artificial intelligence and machine learning will expand the catalogue of jobs susceptible to automation. In Box 2, we explain that in the coming years this will probably concern mainly the tasks that are not fully structured (non-routine aspect), though repetitive (routine aspect).

Globalization and off-shoring, i.e. the transfer of production of goods and services to a country other than the company's country of origin, also contribute to the changes in task content. Routine tasks are transferred from the most developed countries to countries with a cheaper workforce. This process occurs mainly in industry, but also in services (e.g. shared service centres). As a result, the role of routine tasks in the most developed countries is decreasing (Goos et al., 2014). Changes in labour supply, in particular in the education structure, also play a certain role. The rising tertiary enrolment increases the share of workers potentially able to perform non-routine tasks, and reduces the share of workers willing to do routine work.

The adoption of modern technologies has certainly contributed to the growing importance of non-routine cognitive tasks in Poland. Nonetheless, delays in this area also suggest why there has been no deroutinisation of the Polish labour market, i.e. no decline in the importance of routine cognitive tasks that can observed in the US and the UE15. Between the 1990s to the second decade of the 21st century, the ICT capital stock and the number of industrial robots per workers has increased significantly (Figure 3). The value of ICT capital stock per worker in Poland in 2010-2011 was in real terms eight times higher than in 1993-1994.[1] At the same time, it accounted for only 25% of the ICT capital stock per worker in the EU15 in 2010-2011. In absolute terms, it was still smaller than the value of ICT capital stock per worker in the EU15 in 1993. The number of robots per worker in industry in 2016

Box 2. How does the development of artificial intelligence affect the automation of cognitive tasks?

The vibrant progress in artificial intelligence technologies increases the scope of tasks that can be automated, and blurs the boundary between routine and non-routine tasks. The latter can be done by means of machine learning (ML). However, it should be borne in mind that the assessment of the scope of tasks that can be automated through ML is, for now, speculative rather than scientific. The scale of economic applications is not large enough to enable assessment of the impact of these technologies on the labour market in the same way as the impact of computers or robotisation is assessed. However, it can be assumed that ML applications will in the first place be used for tasks at the border between routine and non-routine activities, where the non-routine aspect is connected to, for example, unclear decision-making principles, and not changing preferences. ML technologies are most useful in tasks in which the inputs to and outputs from a system are well defined, the success measures are clear, reasoning does not require diverse knowledge or common sense, and there is no need to explain in detail the reasons for a decision (Brynjolfsson, Mitchell 2017). Therefore, in the near future, they are most likely to be used in the automation of some tasks in shared services for corporate processes (in which it is also easier to collect large data sets) than, for example, in jobs based on interpersonal interactions or requiring the ability to sense the customer's preferences.

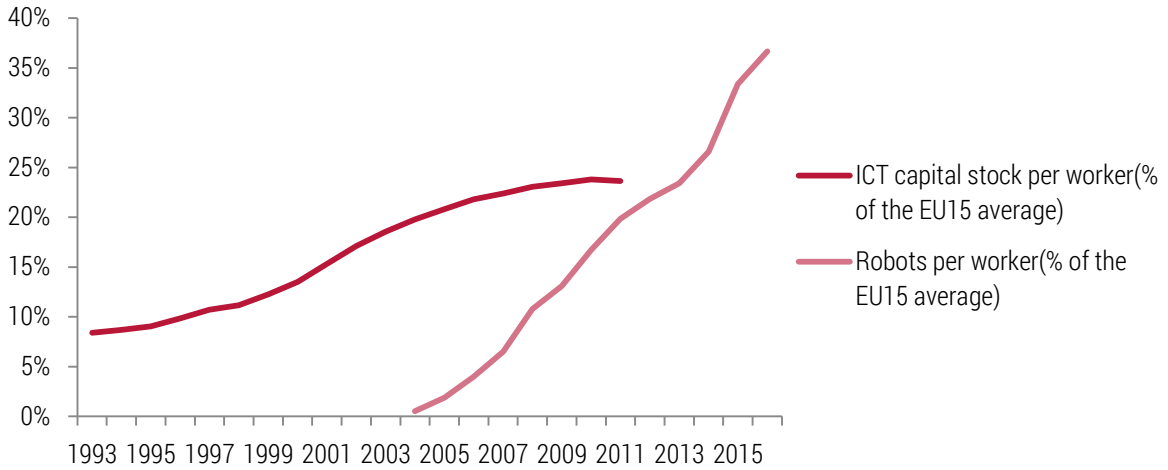
[1] The analysed period reflects the availability of the most recent and oldest data. A similar situation concerns data on robots.

was ten times higher than in 2006. However, it accounted for only 37% of the number of robots per worker in industry in the UE15 on average in 2016, and was three times smaller the corresponding number in the UE15 in 2006. Although Poland is gradually moving towards the EU15 countries in terms of the ICT capital and robotisation (Figure 3), which are the technologies that drive the deroutinisation of the labour market, the gap remains substantial. Moreover, this gap results a large extent from differences in the same sectors, and only to a small extent from differences in sectoral structure in Poland and the EU15 countries.

In the global division of labour, Poland plays a significant role as a performer of routine cognitive tasks. It has become the main location for the business services sector in Europe, and one of the most important locations in this respect globally. According to an association of companies in this sector, in 2017 there were over 1000 service centres with 244 thousand workers in Poland (ABSL, 2017), which is equivalent to 1.5% of the total employment in Poland. In 16 locations the number of workers employed in service centres exceeded one thousand, and in seven locations – 10 thousand (ABSL, 2017). Three quarters of these service centres, employing 80% of the people working in this sector, belonged to companies with foreign capital. In 2017, 55% of the workforce employed in this sector was in business process outsourcing (BPO) or shared service centres (SSC), and 45% in IT and R&D centres. The processes most frequently operated by the centres in Poland are routine-based processes, e.g. accounting, travel and expenditure settlement, customer support / IT service desk, HR administration and reporting, payroll, operating orders (ABSL, 2017). Although processes that require more non-routine tasks, such as software development or project management, have become more prevalent over time, the performance of structured, routine-intensive operations still dominates.

Unfortunately, the impact of technology and off-shoring on changes in the nature of work in Poland cannot be quantified precisely, because of lack sufficiently detailed data. The survey data on labour market do not contain information about technologies used at work nor companies' participation in off-shoring processes. It is possible, however, to estimate to what extent changes in the nature of work can be attributed to changes in the sectoral structure and in the occupational structure, which are indirectly related to technological progress and globalization, and to what extent to shifts in the educational structure of labour supply. The results for Poland,

Figure 3. Although Poland is converging to the UE15 in terms of ICT capital and industrial robots, the differences are still significant

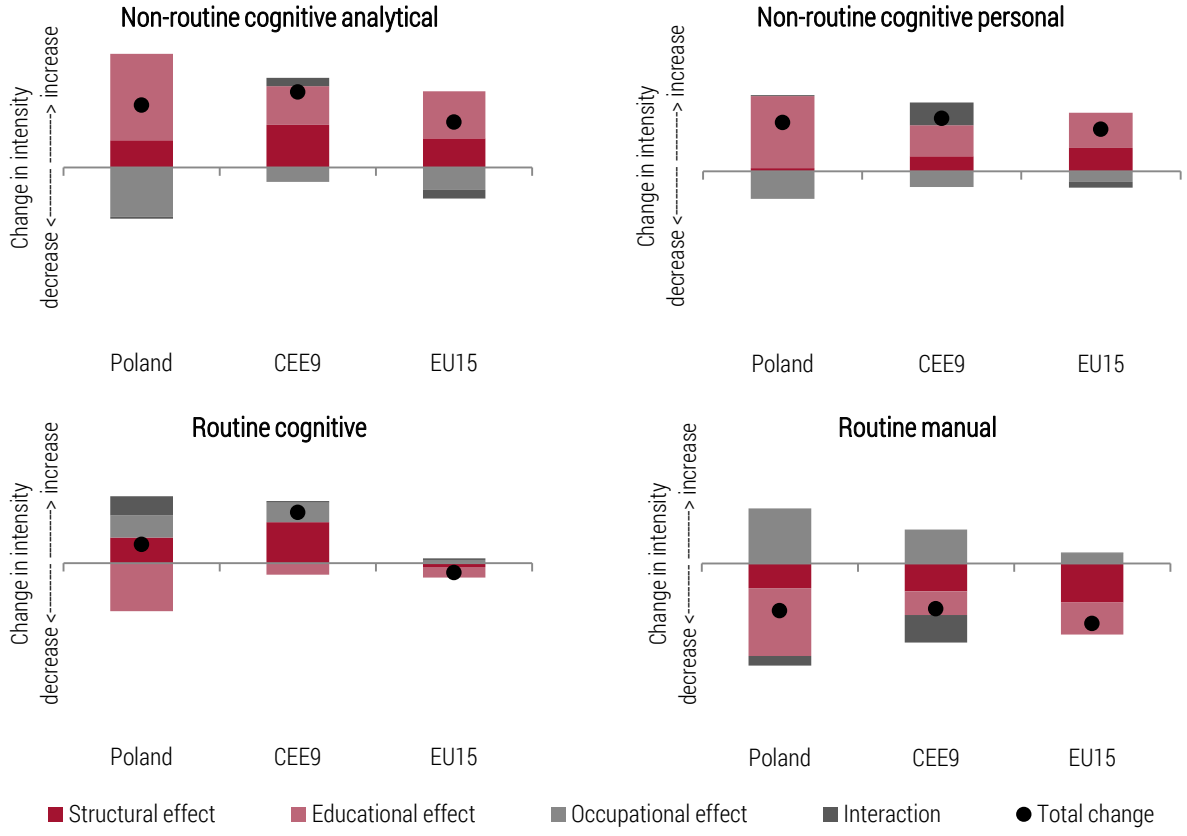


Note: At the time of writing, the data on the ICT capital were available for the years 1993–2011, and the data on the available robots for the years 2004–2016. Both variables are presented per worker and then divided by similar mean numbers for UE15 in a given year.
Source: own elaboration based on International Federation of Robotics, Eden, Gaggl (2011) and Eurostat data.

other Central and Eastern European countries belonging to the EU (CEE9), and the EU15 countries are presented in the Figure 4.

The educational change, namely the increasing number of people with higher education, is the key factor in the growing importance of non-routine cognitive tasks. This phenomenon occurs across Europe, but it is particularly strong in Poland. The share of workers with higher education in Poland increased from 11% in 1996 to 20% in 2004 and 35% in 2017, which was the largest increase in the EU. Changes in the sectoral structure also contribute to the increasing importance of non-routine cognitive tasks. Their key facet is a decline in employment in mining, manufacturing, and the generation and supply of electricity, water and gas (i.e. in sectors where demand for cognitive tasks is small), and an increase in employment in services, in particular transport and communication, financial intermediation, and real estate services, where the demand for non-routine cognitive tasks is high. The effect of structural changes is stronger in the case of analytical tasks than in the case of personnel tasks. Interestingly, in Poland it is slightly weaker than in other countries of our region. On the other hand, changes in the occupational structure limit the increase in the importance of non-routine cognitive tasks. This means that as sectors that create a high demand for non-routine tasks grow, and as the number of people with higher education working in these sectors increases, the tasks of the average worker become a bit more routine. Nevertheless, the impact of structural changes in labour supply and sectoral changes is much stronger and the general importance of non-routine tasks is growing.

Figure 4. Structural changes – the fall employment in agriculture and the growth of employment in services – are the main factor behind the increase in routine cognitive tasks in Poland and other Central and Eastern European countries



Note: Change in the importance of individual tasks between the years 1998–2000 and 2013–2015. Because the results for non-routine manual tasks are very similar to the results for routine manual tasks, we present only the latter ones. CEE9: Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia. Bulgaria is omitted due to data issues.
Source: own elaboration based on Hardy et al. (2018a).

The structural change is the main factor behind the increase in the role of routine cognitive tasks in Poland and other Central and Eastern European countries. Across the CEE region, the share of employment in agriculture, the sector which creates demand primarily for manual jobs, has been falling since the 1990s. Simultaneously, the share of employment in both market and public services has been growing. These developments have been dynamic and translated into an increase in the importance of routine cognitive tasks. In the EU15 countries, such structural change took place largely in the 20th century. In the first two decades of the 21st century employment in clerical, and services and sales jobs have been decreasing, leading to a decline in the importance of routine cognitive tasks.

The occupational change within industries is another factor that contributes to the growing importance of routine cognitive tasks in Poland. Particularly significant is the increase in the share of people working in highly routine-intensive occupations, such as salespersons or clerks. This distinguishes Poland not only from the EU15 but also from other countries in the CEE region. Ultimately, the decline in manual tasks driven by both the demand-side factors (a decline in the share of employment in agriculture and traditional industries, such as metallurgy or mining) as well as the supply-side factors (falling share of people with basic, lower secondary or basic vocational education).

4. Changes in task content vs labour market outcomes

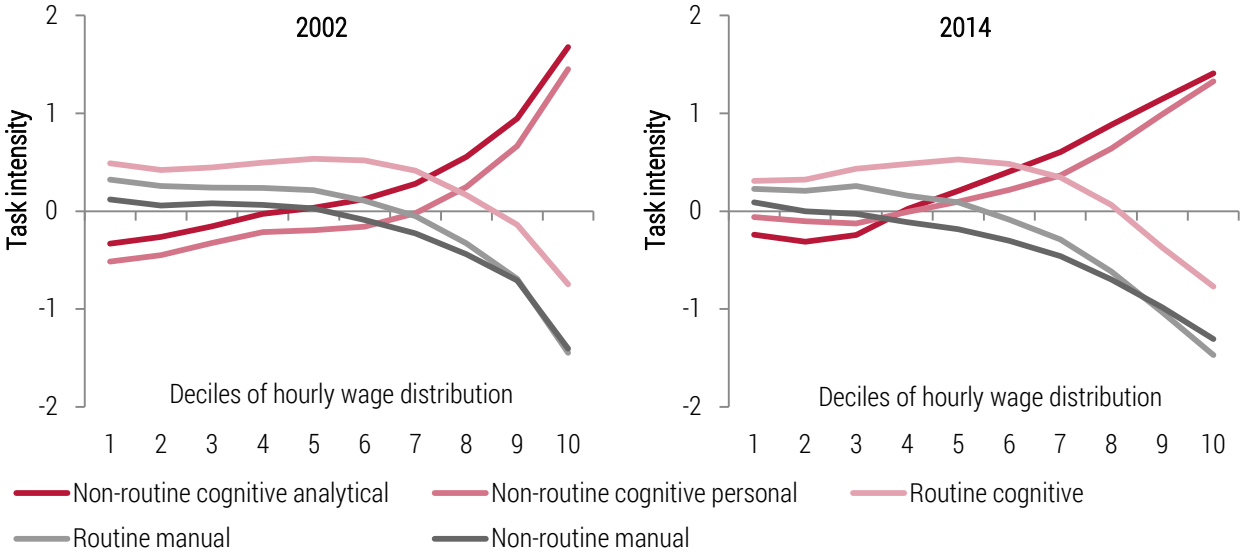
The shift away from routine work and towards non-routine work raises skill requirements and, as a result, contributes to changes in the risk of unemployment among various groups of workers and to the so-called wage polarization.

The workers who perform more routine jobs face a higher risk of unemployment. Studies show that this pattern occurs even if the influence of education, work experience, age, etc. is accounted for. A higher routine intensity is associated with a higher risk of unemployment also in Poland, although the deroutinisation of work has not yet happened (Lewandowski et al., 2017). After an unemployment spell, only few routine workers are able to find a job in a less routine-intensive occupation (Cortes et al., 2016). Moreover, in most European countries, the risk of unemployment related to the routine intensity is higher among young people than among older people. This may seem surprising, because older people generally have lower numeracy skills, are less proficient in using new technologies and exhibit lower occupational mobility than the young. Nevertheless, the share of young people is declining significantly stronger in the more routine-intensive occupations. As a result, routine-intensive jobs "are ageing faster" (Lewandowski et al., 2017). It can be assumed that as technology replaces people in the performance of routine tasks, companies limit hiring of new workers rather than dismiss workers. Such a phenomenon has been identified in Germany as a result of adoption of industrial robots (Dauth et al., 2017).

Deroutinisation of work also leads to so-called wage polarization and increases wage inequalities. The most routine-intensive work is performed by workers who earn wages in the middle of the wage distribution (Figure 5). Performing manual tasks is the domain of 20-30% of workers with the lowest wages, whereas non-routine cognitive tasks are performed by 30-40% of workers with the highest wages. Because so far in Poland the importance of routine cognitive tasks has been rising, no polarization of wages has been observed, unlike in the United States or many Western European countries. However, between 2000 and 2015, the concentration of people performing mainly routine cognitive tasks increased among the 30% of workers in the middle of the wage distribution (deciles 4-6, Figure 5). If in Poland, as in many OECD countries, the current trend is reversed

and the importance of routine cognitive tasks begins to fall, the risk of wage polarization and an increase in wage inequalities will grow.

Figure 5. Routine cognitive tasks are increasingly more dominant among the workers in the middle of the wage distribution, and thus the deroutinisation of the labour market may lead to wage polarisation



Note: The charts present the average relative level of a given task performance by hourly wage distribution deciles in Poland in 2002 and 2014.

*Source: own calculations based on UE-SES and O*NET data..*

5. Conclusions and implications for public policy

In Poland, the importance of jobs that require the performance of non-routine cognitive tasks, both analytical and interpersonal, is growing, and the importance of manual work is shrinking. These are global trends. In Poland, the importance of routine cognitive tasks, which are characteristic for simple office and service jobs, is also growing. This distinguishes Poland from the most developed countries, where such tasks are replaced by technology or transferred to countries with lower wages. Poland is the largest European "recipient" of off-shoring jobs that require relatively routine cognitive activities, especially in shared service centres and business process outsourcing. The growing service sector is a key source of routine cognitive jobs. It offers higher wages than industries based on manual labour and thus contributes to wage and income increase. Also in manufacturing, the importance of cognitive tasks is growing, and of manual tasks decreasing. The changes in the sectoral structure have aligned well with educational changes as the decline in the enrolment at the basic vocational level and the increase in the tertiary enrolment pushed up the supply of people prepared to take up jobs in sectors and occupations requiring cognitive tasks. The several-fold increase in the ICT capital and robotisation, which has occurred in Poland since the beginning of the twenty-first century, is conducive to automation and an increase in the importance of routine cognitive tasks. On the other hand, the level of ICT capital and robotisation in the EU15 countries is still 3-4 times greater. This gap helps us understand why Poland has not witnessed the deroutinisation of work which has been happening for some time in the EU15 countries.

In the future, Poland will probably follow the path of the EU15 countries, and routine cognitive jobs will decline. The faster is the growth of the ICT capital and robotisation stocks, the faster is the decline of technology prices, and the broader is the scope of task automation resulting from innovations, the sooner deroutinisation will occur,

although no specific moment can be indicated. An accelerated growth of the importance of non-routine jobs at the cost of routine jobs would bring Poland closer to more developed economies with higher labour productivity and wages. However, this will entail two challenges for public policy.

The first challenge concerns firms' investments in modern technologies and workers' ability to perform non-routine tasks. High tertiary enrolment in Poland is a good starting point. However, the tertiary education structure should put greater emphasis on science, technology, engineering, and mathematics (STEM). Another key factor, regardless of the level and field of education, is developing the ability to use modern technologies to solve problems, as well as communication and team work skills. Better workplace use of skills already possessed by workers would also increase the potential for performing non-routine tasks. This, in turn, requires better management skills and the broader implementation of such aspects of work organisation as group work, workers' autonomy and freedom of choice as to how to perform tasks, accompanied, however, by mentoring, time for studying and training support provided by employers (OECD, 2016).

The second challenge concerns income inequalities and unemployment risk among workers performing routine tasks. The education system should provide all students, including students with no intentions of obtaining tertiary education, with a certain level of digital competences that will be necessary for every person. For those at risk of losing their jobs as a result of technological progress there should be training programmes that improve their skills and support their occupational mobility. However, a large number of routine workers may no longer be able to change their vocational qualifications to new ones nor upgrade to performing non-routine tasks. Therefore, it is important to develop activities and jobs that are unlikely to be quickly replaced by technology, and for which high technology skills are not required. Examples include jobs in health care, child care or long-term care, as well as jobs related to environmental protection which will be needed if Poland is to manage such challenges as the ageing population and pollution. The shift of labour supply to these occupations would require changes on several levels in the education structure, from basic vocational to higher education, as well as life-long learning programmes. In the long run, the secondary vocational education programmes should be preferred over the basic vocational education programmes as the former provide more of the general skills. Finally, the decline in routine-intensive tasks may translate into wage polarization and an increase in income inequality, which will require a government response by tax and benefit policy aimed at compensating the losers of technological progress.

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Additional information

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