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# Skills requirements on the modern labour markets - challenges and opportunities for CEE countries

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## Abstract

*This paper is elaborated on the relation between ICT and shifts in skill requirements which have taken place in Central and Eastern European countries. It identifies the challenges and opportunities that CEE countries may face in forthcoming years as a result of growing importance of ICT in their economies. It discusses not only SBTC/RBTC/polarisation hypotheses, but also tries to capture the influence of offshoring, telework, and big data technologies on the future skills mix and labour market performance in the CEE countries.*
*Keywords: labour market, routinisation of jobs, polarization, skills requirements, offshoring.*


**Keywords**: labour market, Information and Communication Technologies, performance, CCE countries

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## Introduction

Information and Communication Technologies (ICT) have become ubiquitous in a modern world – they are present virtually in all areas of economic and social live, changing noticeably the way people behave and interact with each other, companies conduct their businesses, and governments provide public services. ICT have also had profound influence on modern labour markets – the employment structure and patterns of labour demand, among others. The most popular hypotheses that may explain these changes, discussed in the literature, cover skill-biased technical change, polarization of the labour market, and routinization-biased technical change. All of these hypotheses refer to shifts in the skills requirements as one of main drivers of these processes.

The paper focuses on these ICT-driven changes on the labour markets in Central and Eastern European countries[1], with special emphasis on development of big data technologies. The analysis reflects also the impact of globalisation, via offshoring, on the prospective labour demand trajectories, and the potential of telework, trying to identify medium to long-run consequences for CEE labour markets. These issues are presented in a descriptive manner – the

[1] The analysis is limited to CEE countries which are the European Union Member States.

aim of the paper is to outline the challenges and opportunities, rather than providing deep, quantitative analysis of discussed phenomena.

## The role of ICT for economic growth in the CEE region

Although the mid-1990s literature was dominated by scepticism about the positive impact of ICT on productivity (known as the Solow paradox), recent studies have confirmed that ICT enhance productivity and economic growth not only in highly developed countries but also in emerging economies, including Central and Eastern European countries (Arendt 2016). At the macro level, two types of effects, related to Information and Communication Technologies' influence on economic growth through technical progress channel, may be identified. The so called first-order effect captures the impact of investments in ICT infrastructure (hardware and software) on the stock of capital (the growth accounting methodology distinguishes between ICT-capital and non-ICT capital). The growth of ICT-capital, ceteris paribus, shall positively influence the GDP growth. The second-order effect is a result of complementary changes that are induced by ICT investments – the literature provides many examples of adoption of organisational changes, new human resource management practices and growing importance of human capital, which are treated as complementary factors (see Brynjolfsson 2005; Dedrick et al. 2013). These complementarities affect Total Factor Productivity (TFP), and as a result – productivity and economic growth.

The characteristic feature of the CEE region[2] is much higher growth of ICT-capital, in comparison to EU-15 countries, being recorded since 1995[3]. ICT-capital grew between 1995 and 2003 by 22.14%, and between 2004 and 2014 by 16.85% in the CEE countries, while in the EU-15 it reached, respectively, 13.36% and 10.24%. This shows that CEE region focused on investing in ICT infrastructure to catch up more developed economies. As a result, the average contribution of ICT-capital to GDP growth in CEE countries exceeded EU-15 level in years 1995-2003[4] (Tab. 1), enhancing the first-order effect. Nevertheless, the main source of

[2] The analysis of relationship between ICT and economic growth in the CEE countries covers Bulgaria (BG), Czech Republic (CZ), Hungary (HU), Poland (PL), Romania (RO), Slovak Republic (SK), Slovenia (SI) in the group of CEE countries, and EU-15 countries (as a point of reference). Estonia, Latvia, Lithuania and Croatia were excluded from analysis due to a lack of data on ICT capital in the Conference Board 2015 database.

[3] The time-span was divided into two periods: 1995-2003, and 2004-2014. The first period covers the post-initial stage of transition of CEE to market economy, taken place after introducing the main reforms, and recession of early 2000. The other period starts in the year of accession of 5 CEE into the EU (on 1st of May 2004, Bulgaria and Romania joined on 1st of January 2007) and captures the effects of financial crisis and global recession. Years 1990-1994 (the very beginning of transition process) were intentionally excluded, because of remarkable instability of CEE economies at that time and low reliability of available statistical data for that period.

[4] However, non-ICT capital was still more important for economic growth than ICT-capital (even in Bulgaria, where contribution of both types of capital was extraordinary high).

economic growth in CEE countries between 1995 and 2003 was TFP – its average growth accounted for half of GDP growth in that period (for EU-15 it was "only" 17%), which means that spillover effects (the second-order effect) was of a great importance. This process was not distributed evenly – in Romania large relative TFP growth balanced the negative contribution of labour and non-ICT capital, while in Bulgaria TFP contribution was large, but negative. Positive impact of TFP on economic growth was present in Poland, Slovakia and Slovenia.

**Table 1. Sources of GDP growth in EU-15 and CEE countries (contribution of production factors to GDP growth)**

| | **EU-15** | **CEE** | **BG** | **CZ** | **HU** | **PL** | **RO** | **SK** | **SI** |
|---|---|---|---|---|---|---|---|---|---|
| 1995-2003 | | | | | | | | | |
| Labour Quality | 0.31 | 0.27 | 0.3 | 0.21 | 0.27 | 0.16 | 0.22 | 0.11 | 0.59 |
| Labour Quantity | 0.81 | -0.54 | -0.54 | -0.45 | 0.14 | -0.29 | -2.02 | -0.42 | -0.19 |
| ICT capital services | 0.61 | 0.72 | 1.09 | 1.00 | 0.94 | 0.44 | 0.36 | 0.65 | 0.55 |
| non-ICT capital services | 0.92 | 1.10 | 1.97 | 1.77 | 1.27 | 0.96 | -0.64 | 1.32 | 1.05 |
| TFP growth | 0.52 | 1.55 | -1.82 | 0.03 | 0.50 | 3.08 | 4.46 | 2.42 | 2.17 |
| 2004-2014 | | | | | | | | | |
| Labour Quality | 0.21 | 0.25 | 0.34 | 0.17 | 0.36 | 0.18 | 0.25 | 0.11 | 0.37 |
| Labour Quantity | 0.07 | 0.00 | 0.1 | 0.19 | -0.41 | 0.65 | -0.66 | 0.39 | -0.26 |
| ICT capital services | 0.48 | 0.93 | 1.43 | 0.26 | 1.63 | 0.75 | 0.39 | 1.48 | 0.59 |
| non-ICT capital services | 0.62 | 1.18 | 3.07 | 1.36 | 0.46 | 1.31 | 0.52 | 0.83 | 0.73 |
| TFP growth | -0.42 | 0.30 | -2.09 | 0.33 | -0.82 | 1.00 | 2.62 | 1.01 | 0.05 |

*Source: Own elaboration based on the Total Economy Database. Average for each period.*

Although in years 2004-2014 TFP did not contributed so much to GDP growth as in the previous period, in CEE countries (with exception of Bulgaria and Hungary) its influence was positive while in EU-15 it became negative. The main drivers of economic growth in the EU-15 countries were non-ICT and ICT capital. The same happened in CEE countries – the contribution of ICT capital to GDP growth was crucial in Hungary, and highly important in Bulgaria, Slovenia and Slovakia. Positive changes in labour quality were often counterbalanced by negative contribution of shrinking employment numbers – like in case of Hungary, Romania

and Slovenia. Generally, contribution of labour quality to GDP growth was higher in EU-15 than in CEE countries.

**From skill-biased technical change to routinization and polarization of the labour markets**

The issue of the relationship between technical progress and labour market has been discussed since Adam Smith and David Ricardo presented their economics principles. However, classical economics with its belief in "invisible hand" and perfect market, which shall ultimately lead to market equilibrium[5], left the issues of labour-saving technical progress outside the mainstream discussion. This problem regained its significance and interest in 1960ties with development and growing utilisation of Information and Communication Technologies in highly developed economies. Manpower Services Commission (1982) identified three possible scenarios of the labour market changes resulting from ICT-driven technical progress:

- overall deskilling (declining demand for skills), resulting from growing automatisation of manufacturing processes. As more and more tasks would be performed by the machines, the need for new skills would be incomparably lower than the pace of depreciation of the old skills possessed by the labour force (economic obsolence),
- polarisation (dualisation) of skills – with growing demand for highly qualified employees, able to develop and operate more and more sophisticated technologies, and declining demand for low-skilled labour force,
- general tendency to skills upgrading, as a result of ongoing development of ICT and structural changes in the highly developed economies towards growing importance of service industry sector – total demand for skills of all kinds shall increase.

Until recently, the most popular, and widely accepted (in developed countries), explanation of changing patterns in skills demand was based on second and third scenario, and took a form of Skill-Biased Technical Change (SBTC) hypothesis[6]. In this approach, it is argued that technical progress favours highly qualified labour. Thus, it was possible to explain growing wage inequalities between skilled and low-skilled labour in the situation of long-lasting increase

[5] Classical economics assumed that labour market achieves the equilibrium after technological shock through reabsorbing labour force that lost jobs because of technical change. Thus, the notion of technological unemployment was practically irrelevant, because in the long run compensation mechanisms (via new machines, decrease in prices, new investments, decrease in wages, increase in incomes, and new products) were in operation – for detailed and critical literature review see (Vivarelli 1995), (Spezia, Vivarelli 2000).

[6] Acemoglu (2002) argued that "The past sixty years must have been characterised by skill-biased technical change" in the U.S.

in demand for skilled workers – it seemed that the demand growth was so dynamic, that even dynamic skill upgrading did not result in decrease of relative wages of skilled labour. And although SBTC hypothesis focused mainly on skilled labour, the version of endogenous SBTC hypothesis seemed convincing enough to explain even past technology-driven labour market developments favouring low-skilled labour[7] (Acemoglu 2002).

However, it appeared recent trends in demand for skills in developed economies have not been consistent with SBTC hypothesis, and many research studies argued that we witnessed labour market polarisation in terms of labour demand and wages (see Autor et al. 2006, Goos, Manning 2007, Goos et al. 2009, Cedefop 2011) – employment has been polarising in favour of high and low-skilled jobs (Jung, Mercenier 2013).

The theoretical explanation of this phenomenon is based on the model presented in seminal paper by Autor et al. (2003). The model analyses the relationship between technology (ICT) and skills/tasks performed in different jobs, arguing that ICT capital substitutes routine tasks and complements non-routine tasks[8]. According to Autor et al. (2003), a task is routine if can be performed by the machine on the basis of explicit programmable rules, while non-routine task is the one to which rules are not understood sufficiently in order to define them in the form of commands executed by the machine. The examples of non-routine tasks presented by Autor et al. (2003) included, among others, deciphering scrawled hand-written notes or driving a car through city traffic. However, in 2011 Brynjolfson and McAfee (2011, p. 14) commented on the Google car experiment, pointing out that Levy and Murnane [2004] were right that automated driving on public roads is extremely difficult task, not easy to be described by binary code, but not impossible. It appeared that driving a car is not anymore a non-routine task, at least in line with Autor et al. (2003) definition, and can be performed by the computer.

As a result, the Routinisation-Biased Technical Change (RBTC) concept[9] evolved, which shifts emphasis from skills to the type of tasks (routine vs non-routine) performed by the employers. As routine tasks tend to be concentrated in the middle of the skills distribution (covering mainly clerical and manufacturing/assembly line jobs), we shall see relatively high share of high- and low-paid jobs (high-skilled and elementary jobs).

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[7] Acemoglu used endogenous SBTC hypothesis to explain changes in labour demand that took place in the Great Britain in 19th century, and was triggered by the industrial revolution. At that time technical change was of skill-replacing nature – high supply of low-skilled labour force that migrated from rural to urban areas (English cities) made profitable to introduce new, skills-complementary technologies (based on steam engine technology). These technologies made craftsmen and artisan (high) skills redundant and replaced artisan shop by the factory and, finally, assembly line.

[8] SBTC hypothesis assumed that ICT complement highly-skilled labour and substitute low-skilled employees.

[9] Less popular, but also used in the literature, is the notion of the Task-Biased Technical Change (TBTC).

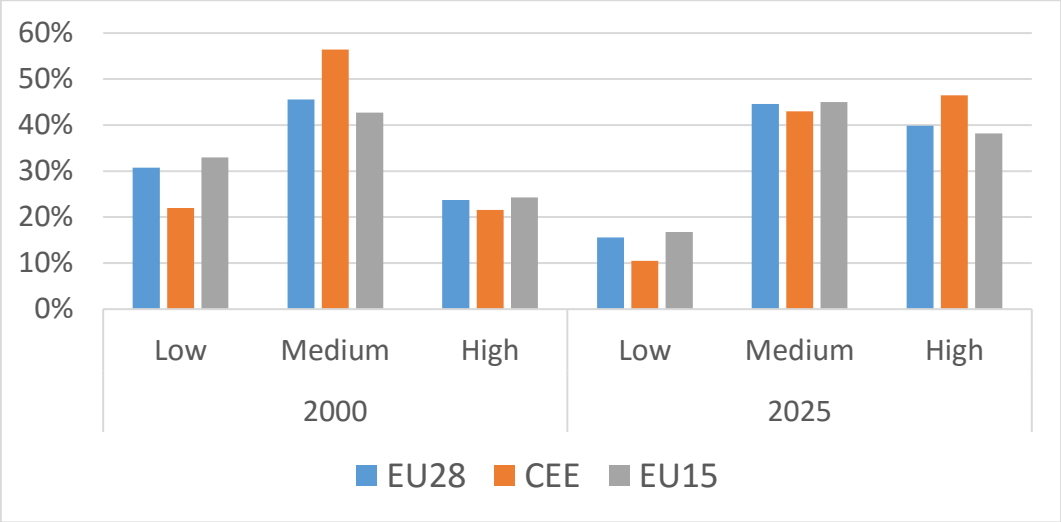
Unfortunately, research studies on SBTC and polarisation/RBTC in the CEE region are very scarce. There is no solid empirical evidence if CEE countries follow the path of other developed economies (U.S. or EU-15), or at which stage they are at present. As a result, it is really hard to decide which hypothesis – SBTC or RBTC may be applied to CEE economies[10]. Leaving aside the issues of wage and income polarisation, we now focus on occupational changes to track the past and future trends in order to try to verify (in a descriptive manner) SBTC and RBTC/polarisation hypothesis. Such analysis may be conducted on the basis of labour market data provided by CEDEFOP, which contains information about, among others, employment by occupational groups (ISCO 08 classification), qualifications, and industries. From the point of view of SBTC/RBTC hypothesis the most important data is related to employment by qualifications, which is available by 3 categories of skills: low, medium and high, for 2000-2025 period[11]. The descriptive analysis of this data leads to interesting observations. In both groups of countries (CEE and EU-15) changes in employment follow similar patterns at both end of skill distribution – share of low-skilled jobs is going to decrease between 2000 and 2025[12], while share of high-skilled jobs shall increase (Fig. 1).

[10] CEDEFOP (2011) argued that occupation polarisation emerged in Europe between 1998 and 2008. However, the analysis was conducted at the EU-27 level, which means it may be inconclusive for CEE countries (EU Member States).

[11] Data is available in Data visualisation tool at http://www.cedefop.europa.eu/en/publications-and-resources/data-visualisations. It includes historical data as well as forecast to 2025. Unfortunately, CEDEFOP does not provide data/forecasts on wages, thus the analysis in this section of the paper is limited to changes in the occupational dimension. It is also worth to emphasise, that skill levels presented by CEDEFOP in the Data visualisation tool are not coherent with skill levels defined by the International Labour Organisation – see (ILO 2012).

[12] This declining role of low-skilled jobs in the future is not fully consistent with other research studies. The results presented by the Cedefop showed secular (since 1970s) upward trend of demand on high skilled occupations in EU-27 and increasing share of elementary (low-skilled) occupations which started at the end of 2000s, and has been – as experts assessed – "quite recent and not particularly significant" (Cedefop 2011, p. 14). Also Oesch and Menes (2011) argued that although employment in Britain, Germany, Spain and Switzerland expanded most at the top of occupational distribution, the U-shaped pattern of occupational upgrading was traceable in the data. However, Oesch and Menes emphasised that previous studies did not provide a clear-cut picture as for polarisation hypothesis, with results depending on the method of measuring the quality of jobs. Therefore, we may assume, occupational developments may follow the forecasted future pattern.

**Figure 1. Employment by qualifications**




*Source: own calculation based on CEDEFOP's data acquired from the data visualisation tool at http://www.cedefop.europa.eu/en/publications-and-resources/data-visualisations*

However, it seems high-skilled jobs will be more important as for total demand in 2025 in the CEE region (46% of total employment) than in the EU-15 (38%). Interestingly, share of medium-skilled jobs between 2000 and 2025 is going to decline substantially in CEE economies (by 13p.p.), while in EU-15 it shall rise by 2p.p. As a consequence, in 2025 the role of medium-skilled jobs in CEE region is projected to be smaller (43% of total employment) than in the EU-15 (45%).

The significant relative decline of demand for medium-skilled jobs in CEE countries may suggest that polarisation of labour market in these economies is taking place with a dynamic pace in coming years, disfavouring clerical and manufacturing jobs. This is an essential challenge to the labour markets and labour market policies in these countries, as it would translate into retraining and skills upgrading need among millions of workers to maintain their employability. At the same time we shall see profound shift in labour demand favouring high qualifications in CEE economies, even stronger than in the EU-15. This in turn may imply that processes described by SBTC hypothesis are still important for shaping employment structure in the CEE region. It seems changes in task content of jobs will be vital in determining future occupational shifts and demand for skills, emerging from ICT-driven technical change in all EU countries.

**The rise of non-routine interpersonal and analytical tasks, and the role of routine cognitive tasks**

The shift of attention from SBTC to RBTC/polarisation hypothesis launched a new set of research studies focusing on task content of jobs, which is related to, but not entirely explained by skill level. It is argued that such procedure is more actual in capturing the recent changes on the developed labour markets. This "task approach", which is usually based on the U.S. description of task content of occupations from the U.S. Department of Labor's Dictionary of Occupational Titles (DOT) and Occupational Information Network (O-NET) database, defines five types of tasks that can be performed within a certain job. Taking reference to description proposed by Levy and Murnane (2004, pp. 47-48), we may distinguish[13]:

- non-routine analytical tasks – focusing on solving problems for which there are no rule-based solutions,
- non-routine interpersonal tasks – related to interactions between people, aimed at acquiring or explaining information, persuading others,
- non-routine manual tasks – these are physical tasks requiring combination of optical recognition and motoric skills, that are hard to describe by exact set of rules,
- routine cognitive tasks – containing mental tasks which can be accomplished by following the exact rules,
- routine manual tasks – these are physical tasks which are well described by rules.

The potential impact of ICT and computerisation processes on these tasks depends on capability to programme if-then-do rules that computer/machine can follow. Thus all routine tasks that have been performed by low or medium-skilled workers are candidates for computerisation, while most non-routine tasks (even manuals ones) are difficult to be completed by ICT without human intervention. In the already cited seminal paper, Autor et al. (2003) provided examples of different tasks and identified potential relationship between ICT and these tasks (Tab. 2). According to their predictions, we shall see ICT substituting routine tasks (analytical, interactive, and manual) and complementing non-routine analytical/interactive tasks, with inconclusive projection as for non-routine manual tasks.

[13] Although this typology has been most common in recent research studies, there are examples of different approaches – e.g. Autor (2007) divided tasks into three broad categories: abstract-complex, routine and manual.

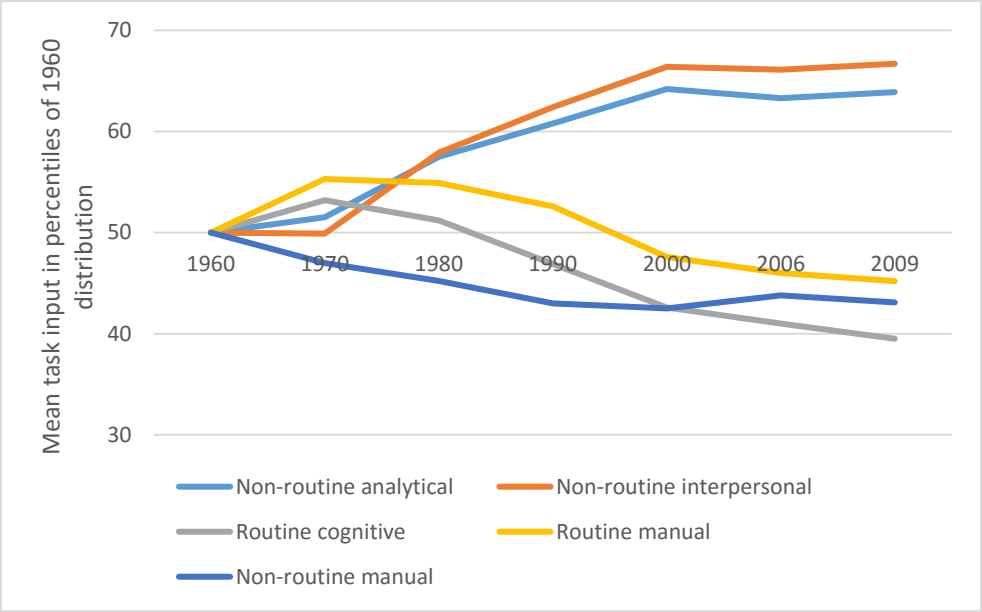
**Table 2. Impact of ICT on workplace tasks**

| | **Routine** | **Non-routine** |
|---|---|---|
| | Analytical and interactive tasks | |
| **Examples** | Record-keeping<br>Calculation<br>Repetitive customer service (e.g. bank teller) | Forming/testing hypotheses<br>Medical diagnosis<br>Legal writing<br>Persuade/selling<br>Managing others |
| **Computer impact** | Substantial substitution | Strong complementarities |
| | Manual tasks | |
| **Examples** | Picking or sorting<br>Repetitive assembly | Janitorial services<br>Truck driving |
| **Computer impact** | Substantial substitution | Limited opportunities for substitution or complementarity |

*Source: (Autor et al. 2003, p. 1286).*

In recent paper Autor and Price (2013) analysed changes in the tasks performed by the U. S. labour force between 1960 and 2009 - it has become evident, that share of employees performing non-routine (both analytical and interpersonal) tasks has increased substantially since 1970s, while the share of labour force employed in routine-intensive (cognitive and manual) tasks has declined significantly (Fig. 2).

**Figure 2. Trends in routine and non-routine tasks in occupations in the U.S. between 1960 and 2009**




*Source: [Autor, Price 2013].*

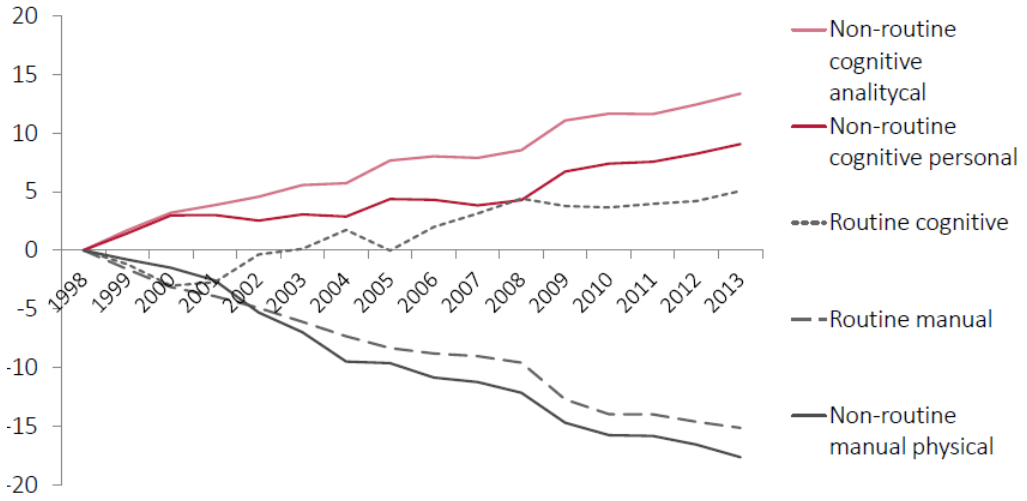
Interestingly, share of labour force performing non-routine manual tasks were declining for five decades, but the trend seems to reverse in 2000. This observation is in line with polarisation hypothesis – ICT is rather complementing than substituting low-end interpersonal service jobs.

Do CEE countries follow similar path to the U.S.? There are not many research studies that would provide answer to this question – in a recent study done by the Institute for Structural Research, Lewandowski et al. (2015) combined methodology presented by Acemoglu and Autor (2011) with EU-LFS and O*NET data to analyse the evolution of task content of jobs in Central and Eastern European countries[14]. The results show that changes in the CEE region are generally in line with trends characteristic to developed countries with one distinct exception – routine cognitive tasks. The intensity of these tasks has been growing in CEE countries, especially since 2006 (Fig. 3), as a joint effect of changes in the employment structure (between-occupation effect) and changes in task content intensities over time (within-occupation effect).

One possible explanation of this phenomenon may be related to the offshoring processes and growing importance of CEE economies as host countries, which will be elaborated in the next section of this paper.

[14] The analysis covered the following CEE countries: Czech Republic, Croatia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia.

**Figure 3. Trends in routine and non-routine tasks in occupations in the CEE countries between 1998 and 2013**




*Source: (Lewandowski et al. 2015).*

Regardless of the reasons explaining the rise of share of the labour force employed in occupations intensive in routine cognitive tasks, this finding shows that ICT-driven technical change on the labour market has not disfavoured clerical jobs in CEE countries to the extent recorded in highly developed economies.

Nevertheless, it shall be emphasised, that development patterns as for routine cognitive tasks has differed between CEE economies. The rise of intensity of these tasks were recorded in Estonia, Latvia, Lithuania and Romania. Relatively stable share was characteristic to Czech Republic, Croatia, Poland and Slovakia, while declining share of labour force performing routine cognitive tasks, similar to developed countries, revealed in Hungary and Slovenia. Thus, it appeared CEE region is not a homogenous group, which imply that some of these economies may facing problems with decline in clerical jobs and, resulting from stronger polarisation of their labour markets.

## Death of distance, globalisation and offshoring

Dynamic development of Information and Communication Technologies enhanced the globalisation processes, since information – the most important factor of the new digital economy – might have been stored and transferred at constantly decreasing cost. This created new business models, new forms of employment, and new opportunities for developed and emerging countries. One of the most influential hypothesis explaining this phenomena was the

concept of "death of distance" described by Cairncross (1997), then complemented by Friedman's idea of a "flat world" (Friedman 2007). The hypothesis was based on the assumption, that technical progress in transportation and, mainly, in telecommunication reduced significantly the cost of moving products and information to long distances, so the distance itself seemed to become irrelevant. And although the "death of distance" hypothesis proved to be premature, and recent studies showed that even cyberspace is spatially concentrated, creating centres and peripheries (Nijkamp 2013)[15], ICT revolution created new possibilities in the economy - from the point of view of this paper, the most important ones are teleworking and offshoring.

Teleworking – the form of employment "invented" by Jack Nilles – might be perceived as opportunity for the CEE labour markets. This opportunity stems from the characteristics of telework (also named as telecommuting or e-working): an employee works at location which is remote to the company premises (it may, but does not have to be employee's home) but electronically connected to its facilities. This may have internal and external positive effects for the national labour markets in the CEE countries. The internal effect is related to spatial disparities in economic development – people (usually highly skilled) who live in less developed areas (e.g. rural) may work for companies based in the centres of growth (e.g. large cities), receiving higher wages but keeping lower cost of living and supporting local economy growth by creating higher demand on goods and services. Similar advantages are related to the external effect, when a person works for company based abroad.

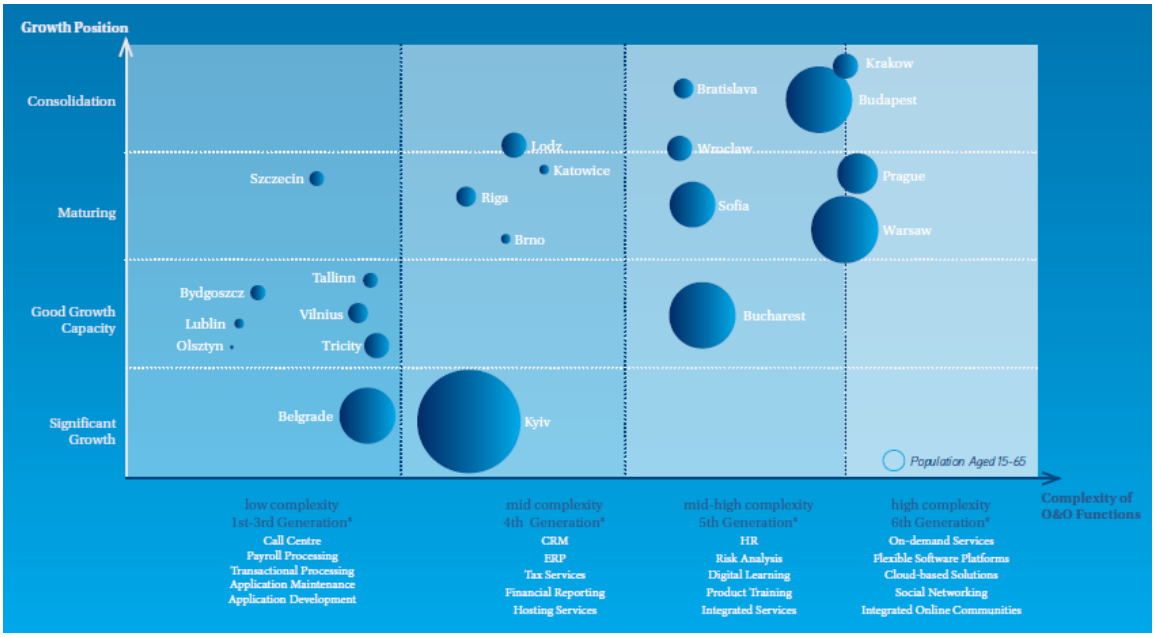
However, it seems that potential of telework in CEE countries has not been fully utilised. This form of employment has not been so popular as many observers assumed – data gathered within the SIBIS project (Statistical Indicators Benchmarking the Information Society) revealed that despite people's interest in telework, only 5% of employees from 9 New Accession Countries (NAC, including most of CEE economies analysed in this paper) worked as teleworkers[16]. There were significant disparities between NAC countries – share of home-based teleworkers varied from 8% in Estonia and Lithuania to less than 2% in Hungary and Slovakia (Graafland-Essers et al. 2003, p. 36-38).

Offshoring has played more important role for the CEE region, its economic growth and labour market developments. Offshoring became popular as a business model in the late 1990s,

[15] Nijkamp argued that even if digital communication patterns are not subjected to Newton's universal gravitation principle, they follow the Tobler's "first law in geography" which states that "Everything is related to everything else, but near things are more related than distant things" (Nijkamp 2013).
[16] In the EU-15 it was 15%, and in the U. S. 25%.

enabling host countries to boost their economies, attract know-how and build new competitive skills. Some CEE countries have taken advantage of the opportunities that offshoring offers. In the 2016 "Global Services Location Index", a ranking of top destinations for global offshoring prepared by A. T. Kearney, 9 out of 55 countries were CEE economies – in the top 20 we find Poland (10th place), Bulgaria (12th place), Romania (13th place) and Latvia (18th place) (AT Kearney 2016). In the 2014 report A. T. Kearney argued that "Central Europe offers a mature industry and highly skilled players. While relatively expensive compared to offshore locations in other regions, there is still substantial arbitrage to be had" (AT Kearney 2016, p. 6). In fact, labour costs in CEE countries still ensure competitive advantage – as McKinsey reported, at the end of 2013 the average hourly wage of the core-CEE markets was 75% less than in the EU-15, and in Bulgaria and Romania they were 90% lower (Colliers 2014, p. 2). The other advantages CEE region possesses are: good quality of life, strong infrastructure, stable business environment and proximity to Western Europe (in terms of culture and physical distance)[17] (Kwacz et al. 2013).

**Figure 4. Outsourcing and Offshoring matrix for CEE countries (as of end of 2013)**




*Source: (Colliers 2014, p. 11).*

On average, structure of the offshoring business in CEE region is positive, in a sense that it encompasses many modern services and technologies. IT/telecommunication sector has

[17] Because of relatively short geographical distance to most European cities (two-hours flight), CEE region is treated as near-shoring services destination for Western Europe.

the highest share (46%), followed by banking and insurance sector (23%), and professional services sector (13%). Energy/industrial sector takes up 8% (Colliers 2014, p. 9). At country (or even local) level quite large dispersion occurs, as far as complexity and maturity of certain offshoring centres are taken into account. Some mature/consolidated centres (Budapest, Warsaw, Prague, Krakow) provide complex services that generate high added value. At the other end, there are smaller centres, which has been focused on rather simple services, but having significant growth potential (Belgrade, Vilnius, Tallinn, Bydgoszcz, among others) (Fig. 4).

However, this dispersion may be perceived as an advantage from the point of view of labour market's challenges with regard to polarisation hypothesis. Jobs in offshoring centres, which provide services of a high complexity, are non-routine tasks (analytical and interpersonal) intensive. Thus, growing number of such centres would lead to growing polarisation of labour market in the CEE region. Therefore, existence of offshoring centres providing low- and mid-complexity services, where many tasks are of routine cognitive nature, gives time necessary to implement measures aimed at adjusting the labour supply (as for skills needed to perform certain tasks) to the demand-side requirements, that in the log-run will probably follow the patterns characteristic to developed countries. In other words, some clerical jobs in the CEE region may be "saved" in the medium run, which will make the polarisation process less severe in economic and social terms.

**Big data – a new challenge or opportunity to the labour market?**

Information and Communication revolution has recently brought a new socio-economic promise in the form of "big data" concept. The term "big data" has become widespread since 2011, and its popularity may be attributed to promotional activities undertaken by the leading technology companies, which are interested in developing this niche of the market (Gandomi, Haider 2015). Big data describes "…large volumes of high velocity, complex and variable data that require advanced techniques and technologies to enable the capture, storage, distribution, management, and analysis of the information" (TechAmerica 2012, p. 10) - this definition encompass three V's: volume, variety and velocity, which are usually perceived as a common framework to explain this term[18].

[18] In more recent approach, veracity, variability, visualization, and value are added to the definition of big data.

It has been argued that big data will fundamentally change the way businesses compete and operate (Ernst&Young 2014), as it has plenty of potential applications. In retail sale business, collecting and analysing of behaviour patterns of a) customer, b) people with similar characteristics to the customer, and c) general public, help to personalise the offer and to customise services or products. Airlines use big data to develop and implement smart pricing strategies. Insurance companies take advantage of big data in order to optimise the insurance premium and minimise losses, while financial institutions assess the risk of certain operations and detect fraud threat by analysing information from the previous transactions (Infosys 2012). Public authorities using real-time analysis of data acquired from mobile network operators may trace people's movements during mass events, preventing congestions which might lead to dangerous incidents. The European Commission has remarked the leading role of big data for the economic development, by outlining in July 2014 the strategy on big data, which should support and accelerate EU transition towards data-driven economy.

It is obvious that implementation of big data concept into business models in private and public sector would require IT/big data specialists capable to operate these new technologies. According to McKinsey's projections, only in the U. S. there is a demand for 140-190 thousand workers with analytical skills (that is about 50-60% talent gap relative to supply), and 1.5 million more managers who would be data-literate, till 2018 (Manylka et al. 2011). At the UK labour market demand for big data specialists grew by 182% per annum between 2007 and 2012, while in that period overall labour demand declined. The highest rise of demand was recorded in the group of big data developers (673% per annum), the lowest – for big data analysts (only 65% per annum). It is expected (under the high growth scenario), that in 2013-2017, the annual demand for big data specialists in the UK will grow by 23% (e-skills 2013).

There is no doubt that development of big data technologies is an important driver of changes in demand for skills. Like every new technology, big data has created a demand for high expertise related to this technology. However, more bothering is if big data would have impact on the whole spectrum of skill requirements and whether "big data skills" would become a part of the EU key competences framework (as a separate competence, or a part of digital competences). That would mean another fundamental change on the modern labour markets (including CEE region), which potentially may enhance polarisation processes. At present, this issue has been perceived as a challenge to the European labour market and labour market policies. In the political discourse, questions about the need to establish new initiatives focusing on the impact of big data on skills requirements and European labour markets has been raised

recently[19]. At the same time, labour market changes induced by development of big data technologies can be seen as an opportunity to CEE countries, provided that part of big data business will be offshored to this region. It seems that CEE economies have many advantages to make it happen These advantages were discussed in the previous section of the paper – here only two are pointed out: extended pool of talents, and the structure of the offshored businesses, where IT sector dominates. These make future prospects promising in the medium and long run, especially for big data specialists from the CEE region.

**Concluding remarks**

Dynamic development and utilisation of Information and Communication Technologies, with recent big data hype, have significantly influenced labour markets in developed and emerging economies. These changes, evident also in the CEE region, have led to profound shifts in demand for labour - in the dimension of task content of jobs and required skills. It seems that CEE countries follow similar skills/job content trajectory as developed countries, with minor but essential differences.

The first difference can be traced in the occupational structure - upward shift in demand for highly-skilled labour and decline of medium-skilled jobs is projected (till 2025) to be of a higher magnitude in the CEE region, than in EU-15 countries. It translates into stronger polarisation of CEE labour market, with slight features of skill-biased technical change, especially in case of higher-end of occupational distribution. This is a real challenge for these countries, as it will require a major skills upgrading from the one hand, and large between- and within-occupational mobility from the other. Thus, creation of efficient lifelong learning systems and strong institutional framework will be of a key importance to meet this challenge.

The other difference is related to shifts in task content of jobs – unlike in the U.S. and other highly developed EU countries, the CEE region witnessed rising intensity of routine cognitive tasks, which is inconsistent with polarisation hypothesis, as long as this type of tasks are good candidates to be substituted by ICT. This process may be perceived as a solution to the previously mentioned challenge, at least in the medium run – it may "save" thousands of

[19] This problem was discussed during one of the plenary sessions of the ICT 2015: Innovate, Connect, Transform Conference which was held in Lisbon in October 2015. This policy conference was aimed at providing information about new policies and initiatives with regard to Research & Innovation in the ICT area, launched by the European Commission.

clerical jobs and provide more time needed to introduce structural changes on CEE labour markets.

Interestingly, offshoring seems to be a mediating factor that maintains relatively high demand for routine cognitive tasks, especially in these countries where offshoring centres, which provide low- and mid-complexity services, dominate. At the same time offshoring centres focusing on high-complexity services will seek for the non-routine analytical and interpersonal competences, putting more pressure on labour market in terms of polarisation. The same may happen in relation with growing utilisation of big data technologies, if CEE countries will capitalise on advantages they have, to become a host region for big data services. However, it should be emphasised, that big data is both a challenge and an opportunity for CEE labour markets. At this stage there are more questions than answers with regard to possible development patterns of big data technologies and their impact on skills and tasks requirements. Would big data skills become key competences? Is there a need to introduce any EU-wide regulatory schemes as for these kind of skills? It remains to be seen in coming years.

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