Digitalization and higher R&D readiness – a way to foster income convergence in CESEE

Juraj Kotian, Zoltan Arokszallasi, Katarzyna Rzentarzewska[1]

After the fall of socialism and a short transition period, Central, Eastern and Southeastern Europe (CESEE[2]) has been outperforming the growth of Western Europe and thus helped reduce the relative gap vis-à-vis the EU-15 in GDP per capita (purchasing power standard) by one-third. The Great Recession has visibly slowed down the pace of convergence, however. The current growth model, which is based mostly on capital accumulation, has thus been challenged, calling for CESEE economies to become more innovative and knowledge oriented. Focusing on returns from different types of investments on total factor productivity (TFP), our panel data analysis suggests that the same amount of money invested in the information and communication technology (ICT) sector tends to have a higher immediate spillover effect on TFP growth than investment in infrastructure or machineries. Although capital accumulation is likely to remain an important growth factor in CESEE in the years to come, a sufficient level of computer skills and Internet usage support knowledge-based investments, yielding relatively high returns. Thus, CESEE economies could potentially benefit from going digital and spending more on research and development (R&D), but on condition that complementary factors are in place.

JEL classification: E22, O30
Keywords: income convergence, CESEE region, digital economy

The economic literature provides a wide array of evidence that Central, Eastern and Southeastern Europe (CESEE) has made enormous progress with convergence. Early studies such as Kočenda (2001) point to convergence in macroeconomic variables even before the year 2000. From the beginning of transition up until the financial crisis, CESEE countries mostly benefited from capital accumulation, high investment rates and FDI inflows (Bijsterbosch and Kolasa, 2009); however, the gains from improving the efficiency of production and productivity changes have also been substantial (Schadler et al., 2006). Rapacki and Próchniak (2009), on the other hand, focus on the role of EU enlargement and its significant contribution to economic growth in CESEE.

Despite CESEE's dynamic catching-up process, the gap between CESEE and the EU-15 in GDP per capita (in absolute terms, price level-adjusted), highway infrastructure and net capital stock per employee remains substantial. Dynamic investment growth was one of the pillars of convergence in CESEE and the underlying force of the catching-up process; the beginning of the Great Recession, however, was marked by plummeting investment activity. Slowing private investment and a reduction of foreign capital inflows became a global phenomenon. Lower investments also reduced total factor productivity (TFP) growth across the world, making the slowdown of CESEE convergence more apparent after the crisis.

Despite recent drawbacks, capital accumulation is likely to remain an important growth factor in CESEE in the years to come; yet, growing attention is being paid to reestablishing the growth drivers toward innovation and research in order

[1] *Erste Group Bank AG, juraj.kotian@erstegroup.com, zoltan.arokszallasi@erstegroup.com and katarzyna.rzentarzewska@erstegroup.com.* *Opinions expressed by the authors of this study do not necessarily reflect the official viewpoint of the Oesterreichische Nationalbank (OeNB), the Eurosystem or Erste Group Bank AG. The authors would like to thank Katharina Allinger (OeNB) for helpful comments and valuable suggestions.*

[2] *In this study, CESEE refers to a group of seven countries: Croatia, the Czech Republic, Hungary, Poland, Romania, Slovakia and Slovenia.*

to sustain CESEE's long-term growth potential. International institutions such as The Vienna Institute for International Economic Studies (wiiw), the Organisation for Economic Co-operation and Development (OECD) (2013) or, more recently, the European Bank for Reconstruction and Development (EBRD) (2017) have suggested that there is a need for a new growth model for CESEE. The OECD (2013) suggests, for example, that more attention could be paid to knowledge-based capital. In many EU countries, investments in intangible assets have been growing steadily. Moreover, after the crisis, investments in information and communication technologies (ICT) have not dropped as strongly as non-ICT investments. We therefore focus on the factors that, along with ongoing investment in traditional forms of capital, would be positive for boosting TFP growth in CESEE, such as investment in ICT, digitalization or research and development (R&D). Especially, evidence shows[3] that in the long run, productivity improvements can account for half of GDP growth (Easterly and Levine, 2001), with the adoption of technologies making up a sizeable share.

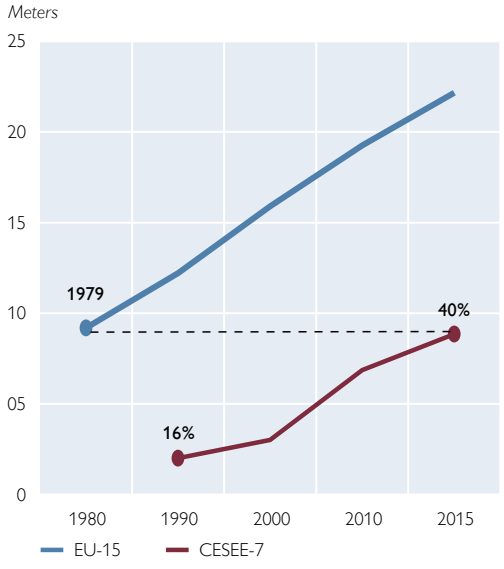
1 Convergence at different speeds

Although CESEE growth has been outperforming growth in Western Europe for the last two decades, the road infrastructure gap between the EU-15 and CESEE remains substantial. On the other hand, the digital infrastructure gap is relatively negligible. Huge differences persist, however, in the quality of road infrastructure, where CESEE countries, despite their recent efforts and access to EU funds, have only reached a highway density comparable to that of the EU-15 in 1979 (see chart 1, left-hand panel). Convergence in areas that require a lot of physical capital

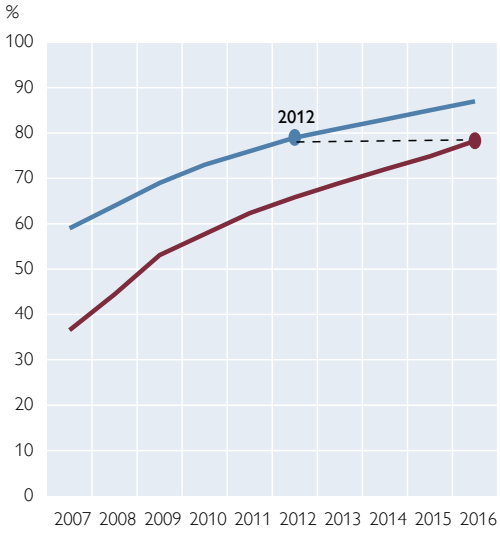
Chart 1

Infrastructure gaps

Highway infrastructure (m of highways per km²)



Households with Internet access



Source: Eurostat, Erste Group Research.

[3] *We use Penn World Table 5.6 capital stock data for 64 countries. Penn World Table 5.6 was released in January 1995 and contains data from as early as 1950 (the capital stock recorded in 1951 is given as initial or the earliest available figure).*

seems to be a lengthy process and the low level of capital stock in these economies is one of the most striking legacy issues. In contrast, the digital infrastructure gap between the CESEE countries and the EU-15 is much narrower and the delay in catching-up is here measured in years rather than decades (see chart 1, right-hand panel). For example, with 79% of households having Internet access, the CESEE region is now lagging only four years behind the EU-15; for access to mobile broadband, the gap is only two years. This gap is mainly attributable to lower household Internet connectivity rates in rural areas in CESEE; there are hardly any differences between Western Europe and CESEE in urbanized areas in terms of Internet access. The digital infrastructure gap is thus far narrower than the 36-year lag in highway infrastructure density.

2 Digitalization as another way of fostering convergence

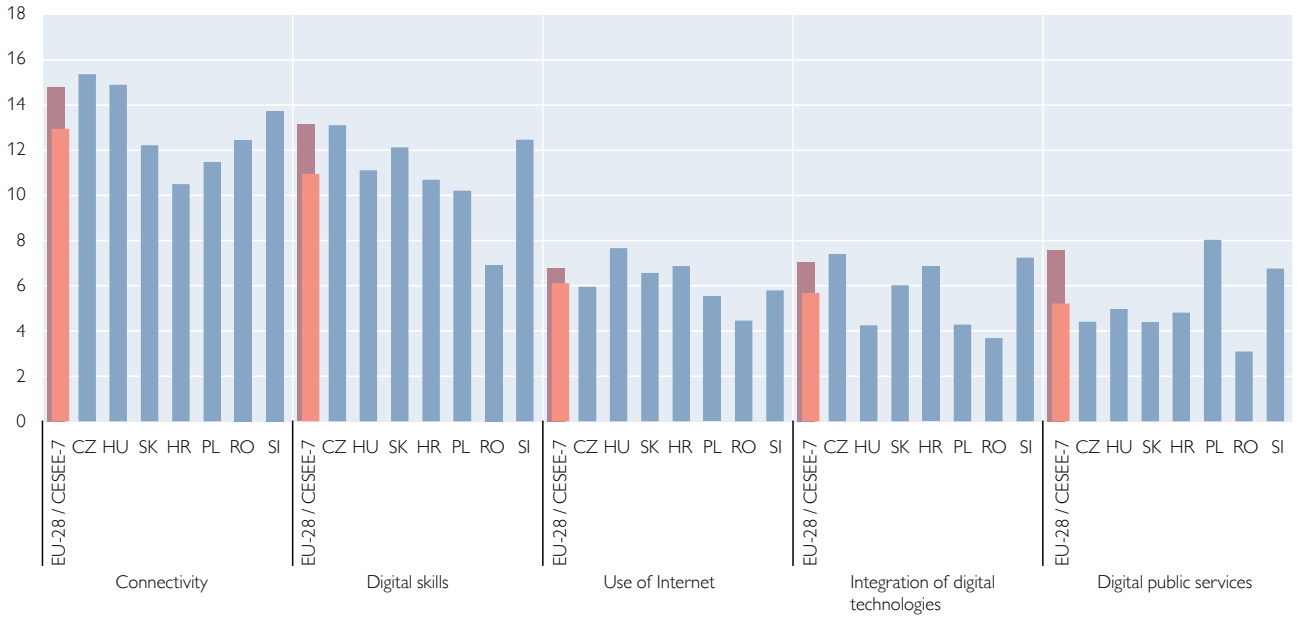
When it comes to CESEE's digital competitiveness, connectivity, Internet use and digital skills are not seen as the major challenges to the adoption and utilization of new technologies. According to the Digital Economy and Society Index (DESI)[4], which measures the digital performance of EU Member States, the Czech Republic is already at par with the EU-28 average in most of the relevant categories, while Romania remains an outlier, drifting from the peers mainly in terms of digital skills and integration of new technologies (see chart 2).

The category in which the CESEE countries have been underperforming most visibly is providing digital public services. We see much room for improvement for CESEE countries in the area of e-government services, with a strong spillover effect into other areas of the economy that would potentially have an overall

Chart 2

DESI indicators 2016

Score in points



Source: European Commission, Digital Scoreboard, Erste Group Research.

[4] *The DESI is for 2016.*

positive effect on the region's prosperity (see discussion in box 1). For instance, a positive correlation between Internet usage in interacting with public officials and the perception of a country's corruption level[5] suggests that digitalization may be a positive factor supporting the level of transparency in government rules and policies and empowering legal equality among citizens. Digitalization can lead to more structured and faster processes, overall cost savings and thus a higher overall satisfaction in society. Going digital seems thus a must when it comes to helping maintain an affordable pace of economic convergence, in particular, and to being ready to scale up business.

Once the prerequisites, i.e. digital skills and/or connectivity, are in place, it seems there should be no major obstacles to stepping up investment in ITC. Increasing the share of investment in intangible assets related to the adoption of new technologies should be of growing importance to CESEE, where rising labor costs challenge the previous growth engine while demographic developments also face strong headwinds.

Box 1

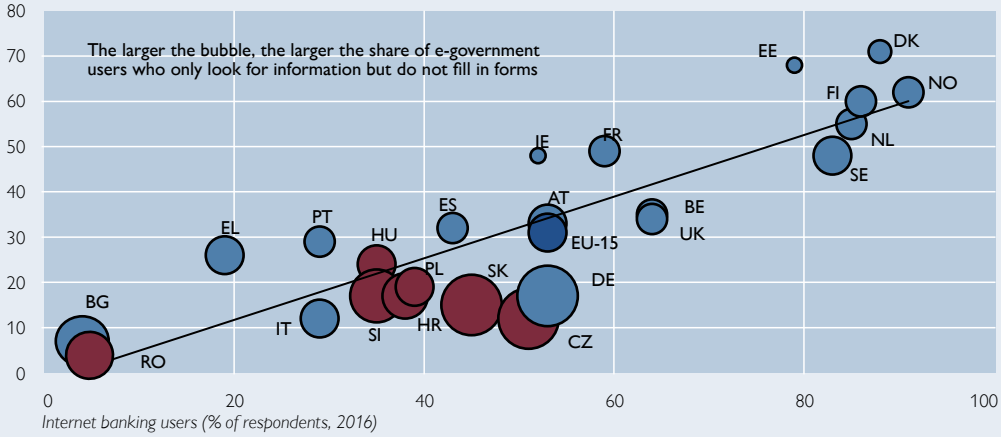
E-government

Most CESEE countries have declared digitalization one of their priorities and have strategies approved for the informatization of their government systems. However, the level of e-services implementation differs across the region. In most CESEE countries, the e-government system remains fragmented. Frequently, there are separate systems in place that require the re-entry of personal data any time citizens decide to use an e-service instead of providing a single entry portal following a once-only principle. In general, the share of individuals in CESEE whose digital interaction with government offices takes place only in a passive form (obtaining information or downloading forms) is relatively high.

Chart 1

E-government services below potential in many CESEE countries

E-government users filling in forms (% of respondents, 2016)



Source: Eurostat, Erste Group Research.

Note: CESEE-7 countries are depicted in red.

[5] *We present evidence on the positive correlation between e-government usage and the Corruption Perceptions Index in Arokszallasi et al. (2017).*

We tried to determine whether the low level of e-government in CESEE is attributable to a supply problem (like poor government services) or a demand problem (lack of digital skills in the population). From a comparison of Internet banking users across European countries, used as a proxy for digital skills, we found that – at least in the Czech Republic and Slovakia – the problem seems to be a supply problem as the share of people interacting with public authorities by filling in digital forms is very small relative to that of Internet banking users or that of users who only gather information or download forms from web pages of public institutions.

We do not think that the underdeveloped status of e-government in most CESEE countries is attributable to a lack of programming skills in the region. We see the lag in e-government as a problem of lacking transparency in public procurement, good governance and strategy. In contrast to Estonia, which is leading the digital change in CESEE, we see a lack of common strategy that would lead to the creation of a common platform to enable the secure exchange of information between decentralized systems.

3 Boosting TFP growth through ICT investment

The key questions in this context are: Can CESEE accelerate economic convergence by focusing on innovation and research, or should their focus remain mostly on investment in tangibles, i.e. on closing the infrastructure gap? Is investment in new information and communication technologies a way to boost productivity and switch to a new, innovation-oriented growth model that would ensure further convergence?

Our estimation of the impact of different types of investments on TFP growth suggests that an increase of investments in ICT or R&D spending affects TFP growth the most. In particular, we look at the returns from "traditional" forms of investment (i.e. in infrastructure, machinery etc.) versus "innovative" types of investment (i.e. in ICT and R&D), which we consider important drivers of long-term productivity growth and efficiency improvements. Our analysis[6], which draws from Gehringer et al. (2014), examines a panel of 14 EU countries[7] over the period from 1995 to 2014. As opposed to Gehringer et al. (2014), who look at sectoral TFP, we run an analysis at the country level. Our results confirm that investment in the ICT sector has a more significant impact on TFP growth than other types of investment (non-ICT residential and non-ICT nonresidential investment). The positive role of ICT in productivity growth is in line with the extensive economic literature on the topic (i.a. Dahl et al., 2011 (Europe); Oulton, 2002 (U.K. economy); Oliner and Sichel, 2000 (U.S. economy)).

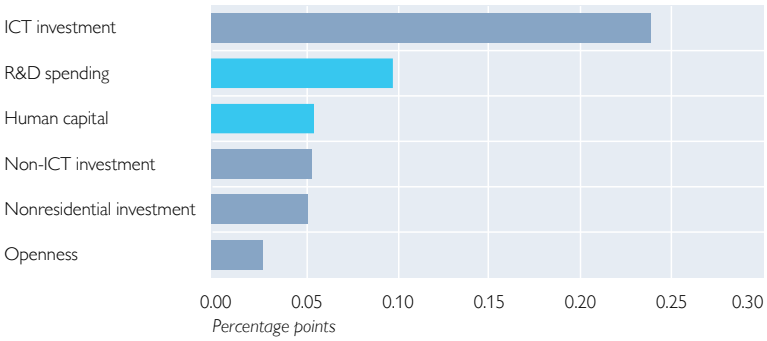
The estimation results suggest that stepping up investments in the ICT sector (worth a one percentage point higher contribution to GDP growth) has about a four times higher spillover effect on TFP growth than other kinds of investments (see chart 3). Thus, boosting TFP growth via ICT investments is less capital-demanding than other investments. Although limited data availability does not allow us to study CESEE directly, we believe the positive relation between investment in knowledge-based capital and TPF growth would hold for the countries in

[6] *In our analysis, we use panel data estimation techniques, in particular fixed-effects estimation.*

[7] *We include Austria, Denmark, Estonia, Finland, France, Germany, Greece, Italy, Latvia, the Netherlands, Portugal, Slovenia, Spain and Sweden.*

Chart 3

Spillover of higher investments[1] to TFP growth



Source: PWT version 9.0, EU KLEMS, Eurostat, Erste Group Research calculations.

[1] Contributing one percentage point to GDP growth.

the region as well. We note that, given the low capital intensity in CESEE compared to the EU-15, traditional forms of investment could yield higher returns in a less developed region (CESEE) than in our analysis of the 14 EU countries above. On the other hand, evidence shows that "growth factors other than the traditional ones, variables related to the human capital and the high technology sector not only proved to be significantly related with GDP per capita growth, but their importance was increasing over time" (Grela et al., 2017). Although the spillover of investments to TFP might differ across CESEE at the moment, it should converge to our findings in the long run.

It is important, however, to notice that the effectiveness of investments in intangible assets is likely to be conditional on complementary factors such as human capital that assure the high level of return of such investments (e.g. Redding, 1996). Furthermore, the effectiveness of R&D spending may depend, for instance, on the nature of funding (private versus public spending; see e.g. Bengoa-Calvo and Pérez, 2011).

4 Prerequisites for R&D spending to be effective

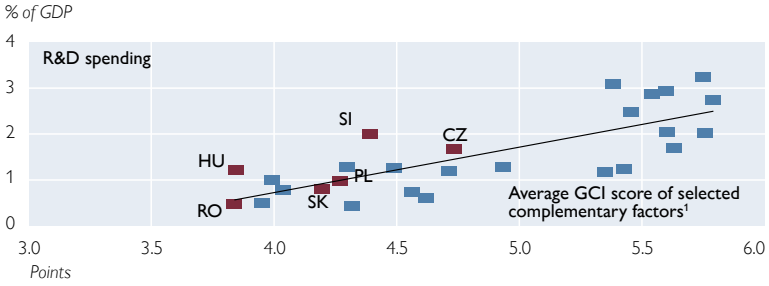
While it is important to focus on investing in intangible assets and not just "brick and mortar," it cannot be taken for granted that higher spending in R&D automatically translates into stronger economic growth. Some prerequisites must be met. What is more, these prerequisites seem to be important for various other types of investments (including investments in ICT, but also more conventional investments). In a recent report, Cirera et al. (2017)[8] pointed out that, without the necessary complementary factors in place in the economy, R&D spending may not reap as strong (monetary) benefits as it may promise. We call the presence of these complementary factors "R&D readiness." As the World Bank (Cirera and Maloney, 2017) proposes, returns from R&D will likely remain low in the absence of a "capital market that would ensure firms to buy the necessary accompanying machinery, managers who know how to take new ideas to market, higher-order human capital necessary to translate greater spending into good quality innovation, and capacity to ensure the investments are located well."[9] Possible barriers, not just to knowledge accumulation, but also to the accumulation of physical and human capital (credit, market entry/exit barriers, the business and/or regulatory climate and the rule of law) are other explicit factors that need to be taken into account

[8] *"Benchmarking innovation or targeting levels of R&D requires taking into account the stock of available complementary factors. In their absence, more R&D is not necessarily better. Hence, while it is not unusual to find unfavourable comparisons of a particular country's gross domestic expenditure on research and development relative to that of frontier countries, and, on that basis, argue that more resources should be directed in that direction, this is only the case if the country also has similar levels of accumulated human and physical capital."*

[9] *See Cirera and Maloney (2017), p. 54.*

Chart 4

Average of complementary factors[1] and R&D-to-GDP ratio (2016)



Source: World Economic Forum GCI dataset (October 12, 2017).

[1] We analyzed the unweighted average of the following complementary factors from the GCI: "Institutions," "Infrastructure," "Higher education and training," "Financial market development," "Technological readiness," "Business sophistication" and "Innovation;" as well as the "Reliance on professional management" subindex from "Labor market efficiency."

Note: CESEE countries are depicted in red.

when promoting R&D or relegating innovation policy solely to a technology ministry. Overall, according to the R&D readiness theory, it is essential to have complementary factors in place before spending on R&D increases, as such complementary factors substantially raise R&D effectiveness.

So how is CESEE doing in a correlation of R&D readiness and (public and private) R&D spending? We take advantage of the World Economic Forum's Global Competitiveness Index (GCI) database, which offers a wide variety of indicators that could qualify as complementary factors over a relatively long period of time (2007–2017) and includes all CESEE and EU countries. Values of the different subindices are restricted between 0 and 6 points. Having defined complementary factors as above, we analyzed the pillars "Institutions," "Infrastructure," "Higher education and training," "Financial market development," "Technological readiness," "Business sophistication" and "Innovation" as well as the "Reliance on professional management" subindex from "Labor market efficiency." We chose a subset of indicators that were positively correlated with the R&D-to-GDP ratio and fulfilled the requirement of being complementary factors (unlike e.g. "Macroeconomic environment"), while they could also be influenced by the government (unlike "Market size"). Data range from 2007 to 2016.

Evidence shows that the CESEE region, on average, does not really spend less on R&D right now than what is warranted by complementary factors (see chart 4).[10] Hungary and Slovenia actually seem to spend too much on R&D, based on the simple model of regressing R&D spending on the average of the GCI subindices, while other CESEE countries seem to roughly spend the amount that is justified by their R&D readiness. Without the described improvement in complementary factors, ambitions to increase R&D spending could be ineffective.

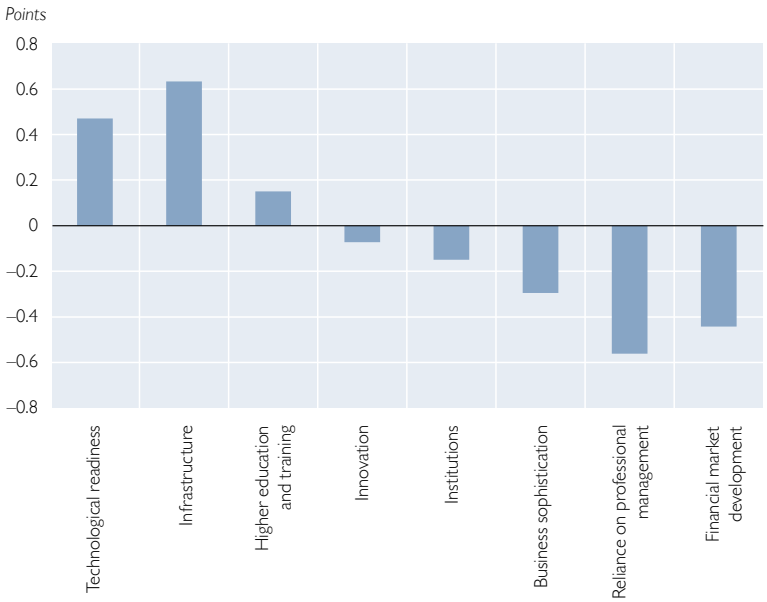
Apart from "Higher education and training," "Technological readiness" and "Infrastructure," it is hard to pinpoint other areas in these complementary factors where improvements occurred in CESEE in the last ten years (see chart 5). "Innovation" (although containing a subindex for R&D spending itself) is particularly problematic, as CESEE witnessed a decline, while the average change in Europe was positive in this area. At the same time, we see that R&D spending, both public and private, as a percentage of GDP went up in almost all CESEE countries (ap art from Romania). In addition to innovation, "Business sophistication" and "Reliance on professional management" also deteriorated substantially. Also somewhat

[10] Looking at the various factors separately, the best independent variable explaining the largest share of variance of R&D spending as a percentage of GDP in univariate models is "Higher education and training" (with an R-squared measure of 0.489), closely followed by "Business sophistication" (0.45). In multivariate regressions on pooled (not panel) data, and also in panel regressions, however, a significant amount of serial correlation and multicollinearity in explanatory variables makes it difficult to draw firm conclusions regarding the results.

underpinning the message of our paper, the strongest increase of indicator values took place in the area of infrastructure, while during the same period, the convergence of income levels to the European average slowed down. This could also underpin the notion that focusing exclusively on tangible investments might be insufficient for speeding up the convergence of incomes to Western European levels.

Chart 5

Change in GCI score (2010–2016 vs. 2007–2009) in CESEE



Source: World Economic Forum GCI dataset (October 12, 2017).

5 Conclusions

The CESEE countries could accelerate economic convergence by going digital more aggressively and better utilizing digital infrastructures. By running a fixed-effects model on a panel of 14 European countries, we found that boosting total factor productivity (TFP) growth via information and communication technology (ICT) investments is less capital-demanding than other investments. Although the CESEE countries are doing well with regard to digital infrastructure and connectivity, they have been underperforming notably in providing digital public services. Therefore, we see a lot of room for improvement in this area, where a lack of a common strategy that would lead to the creation of a common platform to enable the secure exchange of information between decentralized systems still proves to be a stumbling block. The literature also suggests that R&D spending can only be effectively utilized if the necessary complementary factors (institutional framework, business environment, rule of law, human capital) are in place in an economy. We show that the CESEE countries, on average, would first need to improve these complementary factors for higher spending on R&D as a percentage of GDP to have a more sizeable impact on economic growth. While Poland, Romania and Slovakia may appear to stand ready to raise their R&D spending above current levels, thus reaping its potential benefits with their current setup of complementary factors, this rise would be from a relatively low level of R&D spending.

References

van Ark, B. and K. Jager. 2017. Recent Trends in Europe's Output and Productivity Growth Performance at the Sector Level, 2002–2015. In: International Productivity Monitor 33.

Arokszallasi Z., J. Kotian and K. Rzentarzewska. 2017. CEE taking digital path to prosperity. In: Erste Group Research. Special Report. June 22.

Bengoa-Calvo, M. and P. Pérez. 2011. Determinants of Total Factor Productivity in the Spanish Regions. In: SSRN Electronic Journals.

Bijsterbosch, M. and M. Kolasa. 2009. FDI and productivity convergence in Central and Eastern Europe: an industry-level investigation. In: Review of World Economics 145.

Cirera, X. and W. Maloney. 2017. The Innovation Paradox. Developing-Country Capabilities and the Unrealized Promise of Technological Catch-Up. The World Bank Group.

Cirera, X., E. A. Goñi Pacchioni and W. Maloney. 2017. Why poor countries invest too little in R&D. In: Vox, CEPR's Policy Portal.

Dahl, C. M., H. C. Kongsted and A. Sørensen. 2011. ICT and productivity growth in the 1990s: panel data evidence on Europe. In: Empirical Economics 40.

Dobrinsky, R. and P. Havlik. 2014. Economic Convergence and Structural Change: the Role of Transition and EU Accession. In: The Vienna Institute for International Economic Studies. Research Report 395.

Easterly, W. and R. Levine. 2001. What Have We Learned from a Decade of Empirical Research on Growth? It's Not Factor Accumulation: Stylized Facts and Growth Models. In: The World Bank economic review 15.

European Bank for Reconstruction and Development. 2017. Transition Report 2017-2018 – Sustaining Growth. London.

Gehringer, A., I. Martínez-Zarzoso and F. Nowak-Lehman. 2014. TFP Estimation and Productivity Drivers in the European Union. In: Center for European, Governance and Economic Development Research. Discussion Papers 189.

Grela, M., A. Majchrowska, T. Michałek, J. Mućk, A. Stążka-Gawrysiak, G. Tchorek and M. Wagner. 2017. Is Central and Eastern Europe converging towards the EU-15? NBP Working Paper 264.

Haskel, J. and S. Westlake. 2018. Productivity and secular stagnation in the intangible economy. In: Vox, CEPR's Policy Portal.

Havik, K. et al. 2014. The Production Function Methodology for Calculating Potential Growth Rates & Output Gaps. In: European Economy – Economic Papers 535.

Kočenda, E. 2001. Macroeconomic Convergence in Transition Countries. In: Journal of Comparative Economics 29 (1).

Oulton, N. 2002. ICT Productivity Growth in the United Kingdom. In: Oxford Review of Economic Policy 18.

Oliner, S. D. and D. E. Sichel. 2000. The Resurgence of Growth in the Late 1990s: Is Information Technology the Story? In: Journal of Economic Perspectives 14.

Organisation for Economic Co-operation and Development. 2013. New Sources of Growth: Knowledge-Based Capital. Key Analyses and Policy Solutions – Synthesis Report.

Rapacki, R. and M. Próchniak. 2009. The EU Enlargement and Economic Growth in the CEE New Member Countries. In: Directorate General Economic and Financial Affairs, European Commission. Economic Papers 367.

Redding, S. J. 1996. The Low-Skill, Low-Quality Trap: Strategic Complementarities between Human Capital and R&D. In: The Economic Journal 106 (435).

Schadler S., A. Mody, A. Abiad and D. Leigh. 2006. Growth in the Central and Eastern European Countries of the European Union. In: IMF Occasional Paper 252.