



Evaluation of Digital Transformation of Slovakia

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Abstract: *This paper aims to evaluate the level of digital transformation of Slovakia by the use of the index of digital transformation provided by the European Commission, as well as to examine the relationship between digital transformation and economic development. Since digitalisation is crucial to businesses, Integration of digital technology, as one of DESI 2020 dimensions, was analysed in more detail. Comparison, time series and correlation analyses are used for assessing the issue. The author found out that Slovakia lags far behind in terms of digitalisation. Slovakia is ranked 22nd of 28 evaluated countries, slightly below the EU – 28 average. All relevant indicators, including Integration of digital technology, have not improved enough to keep pace with the EU average. Moreover, the author confirmed the dependence of digital transformation and economic country performance. The implications of this relationship are of significant importance to policymakers regarding how much support should be given to encourage digital transformation.*

1. INTRODUCTION

The transition to the new millennium was accompanied by significant social, economic, technical and natural phenomena related to the process of scientific and technical development. The digital transformation of society is an integral part of this process. Today, we can see that Industry 4.0 and Artificial intelligence have an undoubted impact on the lives of inhabitants in both developing and developed countries.

It is natural, that economists and policymakers have started to survey the impact of digital transformation on the way the economy functions. It is supposed to affect, among others, the economic development of the country. Although it can be taken as an engine for speeding up the growth of the economy, at the same time it can hinder this growth if the appropriate background for this incorporation does not exist. The impacts are still uncertain and shall depend on many different factors.

In any case, in the context of the current coronavirus pandemic, it turns out as very important to focus on improving the digital infrastructure and elektronization of the business environment. Countries with a high level of digitalisation are more resilient to economic shocks caused by the coronavirus crisis. They were able to accelerate the digitalisation of various administrative processes - whether it was the rapid acquisition of financial assistance from state support schemes through online tools, or even high-quality digital management of the health part of the pandemic.

Since measuring digital adoption and assessing the extent to which digitalisation may be transforming and affecting different economies is challenging, more institutions are involved in measuring the stance of digital transformation across different countries.

This paper aims to evaluate the level of digital transformation of Slovakia by the use of DESI, an index of digital transformation provided by the European Commission (EC), and to examine the relationship between digital transformation on one side, and economic development on the other side.

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Digitalisation is crucial to businesses. Businesses need digitalisation to support economic recovery, become more resilient, take advantage of innovation and support long-term business growth. The willingness to accept digitization forms the basis for further opportunities and potential for the future. Integration of digital technology, as one of 5 DESI 2020 dimensions, measures the digitalisation of businesses and e-commerce. The author analyzes this dimension in more detail to evaluate the integration of digital technology in businesses in Slovakia.

The author found out that Slovakia lags far behind in terms of digitalisation. Slovakia is ranked 22nd of 28 evaluated countries, slightly below the EU – 28 average. All relevant indicators, including Integration of digital technology, have not improved enough to keep pace with the EU average. The value of the coefficient of determination confirms a close link between the level of digital transformation and economic country performance. The implications of this relationship are of significant importance to policymakers regarding how much support should be given to encourage digital transformation.

2. LITERATURE REVIEW

The success of a country in a global environment increasingly depends on the extent to which it is disposed to create the conditions for the development and implementation of smart digital networks.

Digital transformation, as a new and modern term in business and technological literature, can be described as a set of measures for the introduction of applications of digital technologies and innovations into individual areas of the national economy. As the first step for a comprehensive application, it is necessary to analyze the current situation, then to determine the assumptions and in the last step correctly determine the strategy for the transformation into individual sectors of the national economy.

The term Industry 4.0 was first mentioned at the initiative of the German government, which analyzed the impact of new technologies on the country's economy. It can be considered as the most significant result of the digitalisation of the economy. Artificial intelligence is a very critical tool to accelerate digital transformation.

Concerning the growing era of digital transformation including artificial intelligence, and its growing popularity, an increasing number of authors have shown interest in surveying the relationship between digital transformation and macroeconomic variables. Variables of interest included, among others, output growth, labor productivity, employment, real wages, delivery of services and innovation. Most studies have been implemented on developed and emerging countries, while only few have been directed to developing and lower-income countries. The studies showed mixed results; the majority of them support the positive impact of digital transformation.

The relationship between digital transformation and economic growth has received special attention. The majority of studies confirm that digital convergence positively affects growth and development.

Sabbagh *et al.* (2013) concluded that an increase of ten percent in a country's digitalisation score promotes a 0.75% growth in its GDP per capita. However, the implications of digital transfor-

mation are not the same across different countries. Across developed economies, digitalisation improves productivity and has a measurable effect on growth. By contrast, emerging markets are more oriented towards exports and are driven by tradable sectors. They tend to gain more from digitalisation's effect on employment than from its influence on growth.

These positive consequences on growth do not necessarily take place immediately, actually, Park and Choi (2019) showed that technological innovation advances take time to show impact upon the growth of the different economies, and for its effects to spread all over the economy.

Moreover, the impact of digital transformation does not only take place at the macro level. Digitalisation offers crucial opportunities for businesses of all sizes and in all sectors to set up expand and innovate. Gal et al. (2019) examine cross-country firm-level productivity data and find strong and robust evidence that digital adoption is associated with significant productivity returns at the firm level. In this regard, as the share of micro-firms in Slovakia is the largest among OECD countries, digitalisation is a promising route to scaling.

3. DIGITAL TRANSFORMATION INDICES

Several institutions evaluate managing the digital transformation process, e.g. World Economic Forum, European Commission, Harvard Business Review, etc. Although in different ways, research on the digital agenda seeks to cover the widest possible range of issues that reflect current civilizational changes.

The paper makes use of DESI – the Digital Economy and Society Index² for the evaluation of the level of digital transformation in Slovakia. It is a composite index developed by Cámara and is being published every year by the EC since 2014. It focuses on EU countries in particular to measure the steps and procedures undertaken by those countries towards promoting the digital economy and society.

DESI overall index is calculated as the weighted average of the five main DESI dimensions (Table 1):

- Connectivity (25%), which measures the deployment of broadband infrastructure and its quality.
- Human Capital (25%), which measures the skills needed to take advantage of the digital society.
- Use of Internet Services (15%), as a measure of the variety of online activities performed by citizens.
- Integration of Digital Technology (20%), which measures the digitalisation of businesses.
- Digital Public Services (15%), which measures the digitalisation of public services.

² The International Digital Economy and Society Index (I-DESI) measures the digital economy performance of EU27 Member States and the EU as a whole in comparison with 18 other countries around the world (Australia, Brazil, Canada, Chile, China, Iceland, Israel, Japan, Mexico, New Zealand, Norway, Russia, Serbia, South Korea, Switzerland, Turkey, United Kingdom, and the United States). The I-DESI aims to mirror and extend the results of the European Commission's Digital Economy and Society Index (DESI) by utilising 24 datasets to enable trend analysis and comparison of the digital performance of 45 countries. Analysis showed that EU27 Member States compare well with 18 non-EU countries and the very best EU27 countries have digital performances at the same or higher levels than the best global countries. Indeed, Finland was the leading country in the I-DESI index. Five of the top ten I-DESI countries are EU27 Member States.

Table 1. DESI 2020 dimensions

| | |
|-------------------------------------|--|
| 1 Connectivity | Fixed broadband take-up, fixed broadband coverage, mobile broadband and broadband prices |
| 2 Human capital | Internet user skills and advanced skills |
| 3 Use of Internet | Citizens' use of internet services and online transactions |
| 4 Integration of digital technology | Business digitalisation and e-commerce |
| 5 Digital public services | E - government |

Source: EC (2021)

The DESI 2020 reports are based on 2019 data and assess the status of the digital economy and society before the pandemic. The current crisis is having an important impact on key societal indicators, relating to the use of internet services by citizens. This does not show in the latest 2019 official statistics as reported in DESI. DESI 2020 includes the 27 Member States of the EU and also the UK, since the latest data used in the report refer mainly to 2019 when the UK was still a member of the EU. EU averages include also the UK.

According to the ranking of Member States on the Digital Economy and Society Index in 2020 based on 2019 data, Finland, Sweden, Denmark and the Netherlands have the most advanced digital economies in the EU followed by Malta, Ireland and Estonia. Bulgaria, Greece, Romania and Italy have the lowest scores on the index. It is important to underline that the largest EU economies in terms of GDP are not among the digital frontrunners and this impacts the overall performance of the single market.

The average DESI 2020 of the EU28 member states reached the value of 0.526 (52.6 on a scale from 0 to 100). Compared to the previous year (DESI 2019 for EU28 = 0.494) it increased by 0.032.

A comparison of the DESI value of Slovakia with the EU average for the last 6 years is in Table 2:

Table 2. DESI values for Slovakia compared to EU average, 2015 - 2020

| | Slovakia | | EU |
|------------------|----------|-------|-------|
| | ranking | score | score |
| DESI 2020 | 22. | 45,2 | 52,6 |
| DESI 2019 | 21. | 42,9 | 49,4 |
| DESI 2018 | 20. | 41,9 | 46,5 |
| DESI 2017 | 21. | 38,6 | 43,4 |
| DESI 2016 | 21. | 34,9 | 41,4 |
| DESI 2015 | 20. | 33,1 | 38,9 |

Source: Own elaboration

The total DESI 2020 for Slovakia has a score of 0.452, Slovakia ranked 22nd out of 28 evaluated countries. It is still slightly below the EU-28 average (0.526). Compared to DESI 2019 (score 0.429), it shows an increase of 0.023 points. However, the overall ranking of Slovakia in the ranking of EU countries against DESI 2019 decreased by 1 place (from 21st to 22nd).

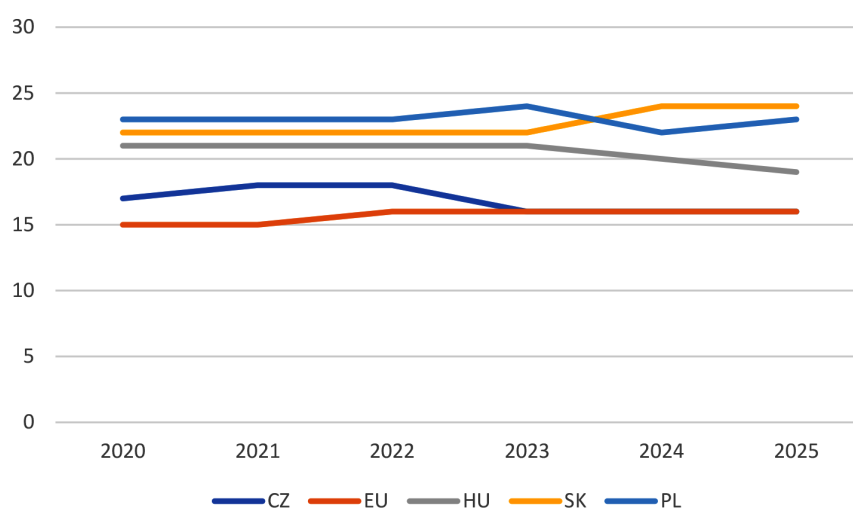
Based on pre-pandemic data (DESI 2020), Slovakia's score increased slightly due to improvements in Connectivity, Use of Internet and Digital public services. However, key indicators have not improved enough to keep pace with the EU average. As a result, Slovakia fell to 20th place in terms of Human capital and Use of Internet services, and 26th in terms of Digital public services (Table 3).

Table 3. DESI 2020 and DESI 2019 for EU average and Slovakia

| | DESI 2020 | | DESI 2019 | |
|---|-----------|--------------|-----------|--------------|
| | EU 28 | SK (ranking) | EU 28 | SK (ranking) |
| 1. Connectivity | 50,1 | 47,5 (21.) | 44,7 | 39,6 (24.) |
| 2. Human capital | 49,3 | 41,8 (20.) | 47,9 | 44,2 (18.) |
| 3. Use of Internet | 58 | 53,4 (20.) | 55 | 51,3 (17.) |
| 4. Integration of digital technology | 41,4 | 32,6 (21.) | 39,8 | 33,1 (21.) |
| 5. Digital public services | 72 | 55,6 (26.) | 67 | 50,7 (25.) |

Source: Own elaboration

Assuming that countries make as much effort to digitize as they have since 2015, their ranking in the DESI index in relation to past trends is shown in Figure1.

**Figure 1.** Forecast of ranking of Slovakia in DESI

Source: Own elaboration according to DESI data 2015 - 2020

The figure shows a persistent weakening of Slovakia's overall position in DESI. According to the forecast, we estimate the decline of the Slovak Republic by 2 places by 2025, which will put the Slovak Republic in the 24th position. According to the current development trend, the author expects the largest decline of Slovakia in the dimension of Integration of Digital Services, from the 21st to the 25th position. On the contrary, the author expects the largest increase in the third dimension, Use of Internet, from the 20th to the 14th position. According to the forecast, the author expects an increase in the V4 countries, especially Hungary and the Czech Republic. The author estimates the most significant step forward in the field of digitalisation for Spain, from 11th to 8th position and Italy, from 25th to 22nd place. Finland remains the leader, followed by Sweden and Ireland.

Further, the author proves that the development of digital processes is important, as there is a close link between the level of digitalisation and economic country performance.

In our case, the author figured out this dependence between the level of digital transformation of the country measured by DESI and the economic level measured by GDP per capita using correlation analysis. The result is graphically expressed in Figure 2. A coefficient of determination indicates that 74,16% of the variation in GDP per capita can be explained by DESI position, ie if the country improves its level of digital transformation, it will have a positive effect on its GDP per capita.

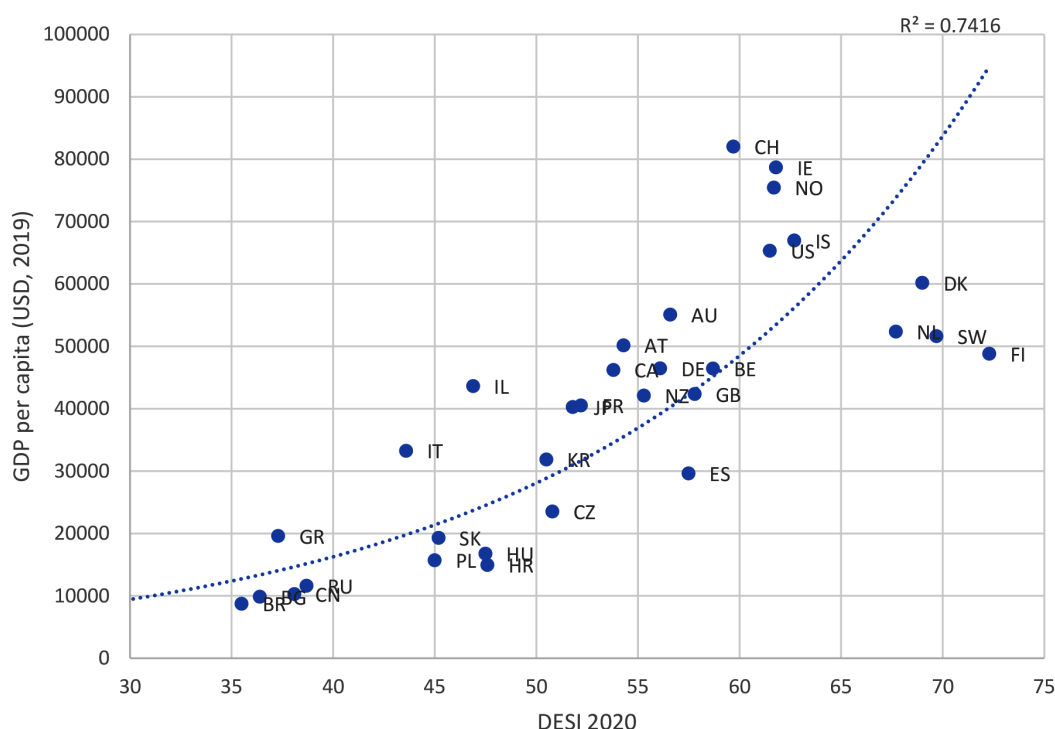


Figure 2. The relationship between economic and digital level

Source: Own elaboration according to EC (2020), IMF (2019)³

Note: Turkey TU, Brazil BR, China CN, Russia RU, Izrael IL, Korea KR, Japan JP, Canada CA, New Zealand NZ, Australia AU, Great Britain GB, USA US, Norway NO, Iceland IS, Switzerland CH, Austria AT, Belgium BE, Bulgaria BG, Czech rep. CZ, Germany DE, Denmark DK, Spain ES, Finland FI, France FR, Greece GR, Croatia HR, Hungary HU, Ireland IE, Italy IT, Netherlands NL, Poland PL, Sweden SW, Slovakia SK

Digitally developed countries are generally leaders in the creation, management and use of digital technologies, and they use these technologies very effectively. They are capable of constantly creating new digital impulses and creating new demand for digital technologies. Maintaining a high level of digital progress supports the growth of their economic performance, which in turn allows them to support the development of digital innovation and technology, thereby a positive growth circle is formed. A low level of digitalisation usually makes the country less attractive to investors.

Many problems and dilemmas, which are brought by the application of digital technologies represent the flip side of the unprecedented opportunities and benefits of digital infrastructure, applications and metadata. New asymmetries arise, the so-called «Digital divide» connected with unequal conditions in access to ICT and resulting in very different impacts on the performance and competitiveness of companies, regions, countries. The uneven uptake and diffusion of digital technologies represent a major source of the productivity slowdown many high-income countries have faced in recent years, as well as the increasing productivity gap between “frontier firms” and firms that lag behind (OECD, 2019 and Andrews, Criscuolo and Gal, 2016).

A growing body of research points out that, unless (digital) technology diffusion among businesses improves, income inequalities may worsen, business dynamism suffer and competition declines. Empirical research confirms that policymakers can make a large difference in this respect (Sorbe et al., 2019).

³ The DESI 2020 reports are based on 2019 data, we used i – DESI for the data of non – EU countries.

There is a very large dispersion in SME digitalisation performance within Europe. The European Commission groups countries into three different categories based on how much an average SME spends on ICT and digitalisation. SMEs in the “high enabling region” consisting mainly of countries in Northern Europe, spend 2.5 times as much as SMEs in the “modest enabling region,” consisting mainly of countries in Eastern and South-Eastern Europe, including the Slovak Republic (with countries in the “modest enabling region” taking an intermediate position). In addition, the gap is not expected to narrow according to estimates of the European Commission. It expects that in 2022 overall spending in the top region will be 12 times as large as spending in the lagging region (Innovation Finance Advisory and European Investment Bank, 2019).

OECD data confirm this picture. In 2017, companies in the Slovak Republic spent an equivalent of 0.84% of GDP on IT investment, below all other OECD countries (OECD, 2020). Consequently, Slovak businesses are not yet fully benefiting from the digital transformation. The use of digital technologies is stagnating.

If we take into account DESI 2020, Integration of digital technology, Slovakia ranks 21st in the EU. Its score decreased to 32.6, compared to 33.1 in 2019. The proportion of companies that share electronic information remained stable at 31% (EU average: 34%). Slovakia falls short of the EU average in the use of big data analysis by companies (9% vs 12%) and the use of the cloud (14% vs 18%). The country’s e-commerce scores have not improved. Only 11% of SMEs sell online (compared to 13% in the previous year), the share of SME turnover from e-commerce remains stagnant at 11%, and the proportion of SMEs that sell online across borders has decreased to 7% (compared to 8% in 2017) (Table 4).

Table 4. DESI, Integration of digital technology

| | Slovakia | | | EU |
|--|--------------------|--------------------|--------------------|--------------------|
| | DESI 2018 value | DESI 2019 value | DESI 2020 value | DESI 2020 value |
| 4a1 electronic information sharing % enterprises | 31% 2017 | 31% 2017 | 31% 2019 | 34% 2019 |
| 4a2 Social media % enterprises | 17% 2017 | 17% 2017 | 18% 2019 | 25% 2019 |
| 4a3 big data % enterprises | 11% 2016 | 9% 2018 | 9% 2018 | 12% 2018 |
| 4a4 cloud % enterprises | 15% 2017 | 14% 2018 | 14% 2018 | 18% 2018 |
| 4b1 SMEs selling online %SMEs | 15% 2017 | 13% 2018 | 11% 2019 | 18% 2019 |
| 4b2 e – commerce turnover % SME turnover | 12% 2017 | 11% 2018 | 11% 2019 | 11% 2019 |
| 4b3 Selling online cross – border % SMEs | 8% 2017 | 8% 2017 | 7% 2019 | 8% 2019 |

Source: Own elaboration

In general, businesses still lack digitalisation support from public institutions, as the regulatory framework is not yet fully adapted to this process. When adopting new digital solutions, companies often rely on help from the private sector. Slovak businesses struggle to find qualified, talented workers to carry forward the digital transformation. Companies do not generally offer quality in-house training to properly upskill their employees. Slovakia does not yet have a digital innovation hub.

On the other hand, Slovakia takes part in all relevant EU initiatives that aim to strengthen the digital single market and foster cooperation in strategic fields such as high performance computing, AI and cybersecurity. At the end of 2019, Slovakia joined other EU countries that work together to develop a quantum communication infrastructure in the EU(20). Slovakia is one of the 20 biggest car producers in the world, making it also an EU leader in robotic intensity. This is mainly thanks to the robotisation of the car industry, but rapid growth in robotic automation has also been observed in the logistics and the service robots sector. Digitalisation is a key economic opportunity for Slovakia.

In 2019, the Slovak government adopted a new Strategy for the Digital Transformation of Slovakia 2030. This document contains a long-term vision and its goal is to manage the economy, society and public administration during this technological change. It also aims to stimulate smart regional development and help researchers and innovators keep up with global trends. The objectives of this strategy are to be achieved through related action plans. The first action plan for 2019-2022 sets out four main objectives: digital transformation of schools, conditions for the data economy, innovation in public administration and support for the development of artificial intelligence.

4. CONCLUSION

Digitalisation has affected not only the industry but also the public sector, which, in response to change, must respond and adapt to processes linked to the economy as a whole. Only a prepared state has the opportunity to benefit from the digitalisation of the economy.

Countries wishing to improve digitalisation should focus on proactively creating regulatory measures in the digital space, educating, improving interconnection availability and digital infrastructure.

According to the Digital Economy and Society Index, which maps progress in the digital transformation of EU countries, Slovakia fell by one place to 22nd place, which indicates that despite our gradual improvement in the level of digitalisation, we are slower than the Member States and our gap with the EU average is widening. In DESI 2020, Slovakia performed best in internet connectivity, where it improved by 3 places in the ranking of countries compared to DESI 2019, and at the same time the difference compared to the EU average is the lowest. All the main aspects of DESI 2020 are below the EU average and Slovakia's position in the third ten of this ranking is not flattering. What's more, 2020 was our historically weakest year in DESI.

Although a growing number of industrial companies are taking steps towards digital transformation, mostly in order to increase their performance and make internal processes more efficient, Slovakia ranks 21st in the EU in dimension Integration of digital technology which measures business digitalisation and e-commerce. A rapid introduction of the measures set out in the national digitisation strategy could help to improve this trend. As a first step, businesses will need more support, advice and enough talented people on the job market.

Because there is a close link between the level of digitalisation and economic country performance as the author confirmed by correlation analysis, position in the DESI ranking has an impact on GDP creation and coronavirus crisis management.

The current global pandemic of COVID-19 pointed to the need for digital solutions as basic support to enable the functioning of the economy and society even in conditions of physical isola-

tion. These lessons only reinforced global trends in the digitalisation of society. For this reason, fundamental changes can also be expected in the position of states in the DESI evaluation.

Old like to say that the world is changing beyond recognition. And that it's all wrong. For some it is true, for many, on the contrary, the world is better. In any case, it is necessary to watch carefully how the world begins to change. Otherwise, there is a threat we will miss the fast train.

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