The Determinants of Competitive Advantage for Europe's Regions: Digital Economy at the Start of the Fourth Industrial Revolution

*Pavel ZDRAŽIL – Ivana KRAFTOVÁ**

Abstract

The goal of this paper is first to evaluate the development of the digital economy of Europe and its macroregions over the past decade, then to map how strongly selected factors have influenced these changes. Research based on the revealed comparative advantage (RCA) approach between 2009 and 2018 was primarily conducted at the level of Europe's main macroregions. Analysis of three most significant global economic leaders shows that China is overtaking Europe's position in the digital economy. Europe's regional aspects are an important negative cause of this development, with these regions exhibiting four different models of how RCA changes. After breaking down RCA development, shift-share analysis revealed that global influences, working as exogenous factors for increasing competitiveness, contribute the most to digital economy competitiveness. In second place, the economies' competitiveness is influenced endogenously by their institutional framework, which shapes the factor concerning regional characteristics that affect all sectors.

Keywords: *Fourth Industrial Revolution, digital economy, European macroregions, revealed comparative advantage, shift share analysis*

JEL Classification: O33, R11, F14

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Introduction

The second decade of the 21st century is associated with the introduction of global strategic discourse tied to a vision of Industry 4.0, and the Fourth Industrial Revolution, respectively. The product of the Fourth Industrial Revolution is

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a digital economy based on digitizing production processes and robotic equipment, digitizing services, and connecting the digital virtual world with the real world – with trends directed at cyber-physical production systems and an internet of things (Barbosa et al., 2019; Sanghavi et al., 2019). Building effective digital economy infrastructure is considered to be a basic condition for improving international competitiveness and for eliminating regional differences (Balcerzak and Pietrzak, 2017). The digital economy is changing society as a whole. It is impossible to ignore this. This issue, or the dynamics of its development, is what will decide the success or failure of national and regional economies. Therefore, its concept must be included in development strategies, which should be developed and adopted with the consent of societal partners – the government, employers, and unions (Mas and Gomez, 2020).

In a globalized, intensely interconnected world, it will be necessary to realize that economic success takes place in a highly competitive environment (Yalcinkaya et al., 2015). Not only building effective digital economy infrastructure but also primarily using it effectively in all types of production and services will make it possible to change individual players' relative positions (Witt and Gross, 2020). At the same time, it is clear that a range of factors influence how results are achieved. In order to create growth-enhancing development strategies at the Europe-wide and national levels, it is vitally necessary to have access to information about positioning within the global economy – its current state and alteration, or respectively, global economic dynamics and trends (Safiullin and Salahieva, 2015). Moreover, this information must primarily be from the perspective of the digital economy.

The goal of this paper is therefore to evaluate both how the position of Europe's digital economy and those of its regions have been evolving over the past decade as well as to map how strongly selected factors have influenced these changes. It is also concerned with positioning from the perspective of revealed comparative advantage, newly reworked to include the indicator of digitally-deliverable services in reaction to technological, economic, and social changes related to the Fourth Industrial Revolution. Considering the research goal, the following questions stand out in particular:

1. How is Europe's position changing in relation to the world's largest economies and what influences these changes at most?
2. What distinguishes the development of competitive advantage in European macro-regions and which factors can be identified as the causes of these differences?
3. Which factors and how do they influence the development of the digital economy at the level of European countries?

It should also be noted that the changes coming with the Fourth Industrial Revolution, in particular the digital economy and digitized processes, are currently gaining momentum thanks to the COVID-19 pandemic. In this context Roese (2021) therefore, makes the following appeal: *"Subjects without robust internet access are being left behind academically and economically. We have a moral imperative to ensure everyone can be part of the Fourth Industrial Revolution."*

1. Literature Review

The issue of the Fourth Industrial Revolution and expanding the digital economy is entirely interdisciplinary in nature, due to its impact on practically all of society. However, it has not as yet been clearly and universally defined (Schor, 2017; Kristoffersen et al., 2020); consequently, it has been examined from many perspectives in academic literature. Even before its actual advent and expansion, Malecki and Moriset (2008) predicted that extremely dynamic growth and the volatility of digital technology would complicate economy management and simultaneously create a space where unequal division of access to digital environment, tools, information, etc. would cause fundamental problems. Today, it can be said in hindsight that these words have essentially been confirmed.

1.1. State of Knowledge

A number of studies have focused on the issue of institutional transformation of the economy, which currently consists mostly of the need to revise legislation that has fallen behind the times. In most countries, the institutional framework has been established on the traditional economic model, with clearly defined bilateral relationships between players; therefore, it is not good at adequately regulating the new system that has been realized in the digital environment (Garben, 2019). In this sense, studies have most often focused on dealing with taxation issues (Noonan and Plekhanova, 2020), setting quality standards (Orhan and MacIlvaine, 2020), labor law (Yangin, 2020), or other areas, with consumer protection, safety and health protections, intellectual property rights, and equal opportunities being among those most prominently represented (Lobel, 2016).

Other main trends deal with the issue of disrupting the competitive environment – specifically, market domination and its abuse in certain fields by global digital platforms such as Facebook, Google, Amazon, Uber, and Airbnb (Ciriani and Lebourges, 2018). Moreover, certain studies have tried to discover new modifications of market models that would preserve competition in the digital environment (Franc, 2020).

In conjunction with the digital economy, Europe's academic community has been paying marked attention to implementing the Digital Single Market policy, which was one of the Juncker Commission's top 10 priorities for 2014 to 2019 (European Commission, 2015). However, regarding the agenda's novelty, these studies' conclusions have so far tended to limit themselves to evaluating goals and the methods used to attain them (Renda, 2017) rather than evaluating policy's real-world impact on the economy. However, they often point to the fundamental significance that regional disparities have for the digital economy's degree of development and regulation; these are the consequences of individual countries' varying approaches and are considered to be fundamental barriers to the digital economy's development across the European continent (Luis, 2018; Camisao and Guimaraes, 2017).

Chiappini (2014) pointed out the significance of differing regional models of technological specialization in eurozone countries at the cusp of the millennium. Digital competitiveness (Laitsou et al., 2020), i.e., the digital transformation of economies or even whole societies (Jurcevic et al., 2020), has become a thoroughly legitimate subject when analyzing the positioning of national economies with respect to their surroundings. For this, the previously mentioned works have used the International Digital Economy and Society Index (I-DESI), whose purpose is to monitor the development of the EU member countries in the area of digital competitiveness[1] (European Commission, 2020a). The latest results of the 2020 I-DESI (European Commission, 2020b) show that EU countries outperform their global counterparts in digital skills; however, as a group, they lag behind in digitizing public services.

The I-DESI was also used by Fernandez-Portillo et al. (2020) in their analysis of the impact of information and communication technology (ICT) on economic growth in EU countries that are currently OECD members. Their empirical results led to the conclusion that progress in implementing and using digitization drives economic growth in the countries analyzed. As to other studies, Min et al. (2019), for example, devoted attention to analyzing the effects of ICT – seen as the foundation of the Fourth Industrial Revolution – on the machinery and equipment industry, which most frequently implements intelligent production with the use of digitization, for the leading global economies of the USA, Germany, Japan, and China right before the Industry 4.0 vision was introduced.

Even taking into account the newness of the subject, there are still too few analytical studies available offering a more comprehensive solution to the dynamic of how competitiveness evolves in relation to the digital economy's development within the main European regions or countries. Additionally, there are no existing studies that satisfactorily explain the determinants of these ongoing changes.

[1] First calculated in 2015.

Therefore, the ambition of this study is to at least partially fill this niche and thus contribute to advancing knowledge in the field of the digital economy's development at the European level. To achieve this, we employed an approach based on competitive advantage, in particular, the revealed comparative advantage (RCA).

1.2. Revealed Comparative Advantage Approach

Comparative advantage, which is based on the theory by Ricardo, can be investigated using various approaches. In addition to the method of the domestic resource cost ratio, the method of RCA has been being put forward more frequently.

At the same time, the method itself has a number of modifications (Vollrath, 1991). The standard Balassa model (1965) of export RCA, conceived as a location quotient, can be considered its first model. Donges and Riedel, (1977) presented a more complex model, likewise conceived on the basis of a location quotient but including net exports and foreign trade turnover in their comparison, in addition to exports and imports. Bojnec (2001), for example, also used another RCA modification in his study, which prioritized the Grubel-Lloyd index (1971) for evaluating RCA in the field of agricultural production. Mirzaei et al. (2012) criticize the asymmetry of Balassa RCA and prefer its symmetrical modification. Certain authors implement a combination of RCA models and then describe the investigated problem using the results, e.g., Havrila and Gunawardana (2003) compare Balassa RCA results with Grubel-Lloyd index results and results from the Vollrath model (1991), which introduces the difference between export RCA and import RCA as relative trade advantage.

One could say, dozens of RCA approaches have developed over the years. Sanidas and Shin (2010) discussed some of them and suggest to classify the approaches into three main classes: (I) trade-cum-production indexes containing both of trade and production variables; (II) exports-only indexes containing only exports variables; and (III) indices using hypothetical situation such as comparative advantage neutral point. However, Aho et al. (1980), Ballance et al. (1987), Sanidas and Shin (2010), Vollrath (1991) and many others propose to prefer net variables into consideration, i.e., the class (I) models.

It can be said that each of these approaches has its advantages and disadvantages. Primarily, the level of complexity, availability of data, clarity, and interpretation's impact – as well as the actual problem being investigated – all enter into play. After considering the pluses and minuses of various models, we selected a class (I) model to evaluate the digital economy's RCA (quantified by the digital services indicator, see below) that depicts a country or region's export attractiveness in this field in a relatively illustrative way, without even leaving out imports' significance for economic development – (1), in which case $RCA \in -1;1$.

$$RCA_{ij} = \frac{X_{ij} - M_{ij}}{X_{ij} + M_{ij}} \tag{1}$$

where

X_{ij} – value of exports in USD,
M_{ij} – value of imports in USD,
i – i-th country, or region,
j – j-th product, here digital services.

The RCA index (1) encompass both supply and demand effects and is, in this respect, more consistent with the theoretical concept of comparative advantage than single aimed RCA indexes (Vollrath, 1991) – i.e., class (II) and (III) models. The extreme negative value indicates the absence of exports in the given country or region; conversely, the extreme positive value depicts the absence of imports of the given commodity. A prevalence of exports over imports within international trade in the digital economy can be seen in the interval $(0;1\rangle$, and the country can be classified as attractive, which shows the revealed comparative advantage in the field being investigated. Results in the interval $\langle -1;0)$ position the country or region as unattractive, without revealed comparative advantage.

For the purpose of identifying factors that contribute to achieving RCA, the economies' development underwent in-depth analysis using shift-share analysis (Dunn, 1960), specifically, the multi-factor partitioning (MFP) modification was used (Ray, 1990). This makes it possible to break down the evolution of the regional indicator – in this case, digital economy turnover or digital services – into 5 components, see (2), instead of 3 components, which contains the classic shift-share analysis model. The digital economy turnover or digital services was used as the basis for calculating RCA and has the advantage of reflecting the combination of exports and imports simultaneously.

$$x_j^t - x_j^0 = NS + AE + IM + RS + MR \tag{2}$$

where

$x_j^t - x_j^0$ – digital economy turnover over the period <0; t>,
NS – the national component (the influence of the higher-level region),
AE – the allocation component (the influence of the sector's distribution within the higher-level region),
IM – the sector mix component (the influence of the sector's development in the region vs. standardized sector development within the higher-level region),
RS – the regional component (the influence of regional characteristics affecting the economy as a whole),
MR – the sector/region interaction component (the influence of regional characteristics affecting only the sector being studied).

Specifically, it is possible to quantify these components using (3)

$$x_j^t - x_j^0 = x_j^0 r + x_j^0 \left(r - \hat{r}\right) + \sum_i^m x_{ij}^0 \left(\hat{r}_i - \hat{r}\right) + \sum_i^m x_{ij}^0 \left(\hat{r}_j - \hat{r}\right) + \sum_i^m x_{ij}^0 \left(r_{ij} - \hat{r}_i - \hat{r}_j + \hat{r}\right) \quad (3)$$

where

x	– symbolizes the value of the indicator,
r	– the relative change in the indicator's development,
$i = 1, \ldots, m$	– the sector,
$j = 1, \ldots n$	– the region,
0	– the first period,
t	– the final period,
^	– that the value is standardized.

One could point out, however, the shift-share analysis, as well as the MFP modification employed, has its limits. These limits rest in data standardization, level of disaggregation, industrial interaction and policy implications, in particular. Ray (1990) provides an extensive discussion about these effects in his seminal paper. All at all, the biases in MFP have similar causes as in the case of RCA measures – they are based on real-world data which are somewhat influenced by market distortions (Vollrath, 1991).

2. Methods and Data

Regarding the principles of shift-share analysis, which depicts the changes between two periods, the average ratio for 2009 to 2013 is considered the beginning period (0), and the final period (t) is the average for 2014 to 2018 (see below) for the needs of this paper. It can be assumed that this substitution sufficiently curbs any deviation in values for specific years, thus providing more credible information on the indicator's development over the period as a whole. The overall volume of services in the given economy expressed in accordance with standard BPM6 (IMF, 2009) is used as the base ($\sum i$), to which the evolution of digital services turnover is related. Limiting the economic analysis to the area of services is deliberate, because it is precisely on the volume of services that the digital economy has entirely unprecedented impact (IMF, 2014).

The breakdown concept that was selected satisfactorily eliminated all main limitations of the classic shift-share analysis model (Lamarche et al., 2003), specifically: (I) insufficient division of concurrent effects from the sector mix component; (II) arbitrariness in the breakdown; (III) the difficulty in comparing the results across various regions and over time; (IV) the difference in weights for individual results; and (V) the dependence of the resulting values on the model used (Xanthos and Psimarni, 2019).

Digitally-deliverable services, which was proposed and designed as part of the Partnership on Measuring ICT for Development, was selected as the indicator for evaluating the digital economy (UNCTAD, 2015). Digital services include not only two groups of ICT services according to ISIC Rev. 4 (i.e. telecommunications; computer services including computer software) but also seven categories of what are called ICT-enabled services – sales and marketing services; information services; insurance and financial services; management, administration, and back office services; licensing services; engineering, related technical services, and R&D; and education and training services (UN, 2008).

ICT-enabled services are considered a quickly growing component of the digital economy, offering distinct opportunities for development and increasing productivity and competitiveness, which however was previously missing in the internationally established definition. Nevertheless, UNCTAD's technical report (2015) recommends to define it as: "*ICT-enabled services are services products delivered remotely over ICT networks,*" whereby they are clearly differentiated from services involving the physical movement of goods and people.

Thus, digital services and trade in them are an economic component that incorporates a distillation of the Fourth Industrial Revolution's ramifications, linked to the digitization of production processes, or respectively, interconnecting the digital virtual world with the real world. At the same time, for evaluating RCA, both digital service exports, which show this segment's strength and competitiveness vs. the surrounding economies, as well as their imports, which conversely indicate the economy's capacity for absorbing these elements, are important. These elements energize the economy during integration into the processes of the Fourth Industrial Revolution.

This paper is focused specifically on the impact of the Fourth Industrial Revolution. The starting point of its advent, which is usually linked to the presentation of the closing report of the German Industry 4.0 platform in 2013 (Kagermann et al., 2013), is therefore considered a milestone. The subject of analysis is the period of 2009 to 2018 (latest data available in the database UNCTADSTAT, 2020). In order to identify the Fourth Industrial Revolution's potential impact, the monitored time period is further divided into 2009 to 2013 (uninfluenced by the impact of implementing the Fourth Industrial Revolution) and 2014 to 2018 (potentially influenced). The nonparametric Mann-Whitney U test (for a significance level of $\alpha = 0.05$) was used to depict how the indicators' development differed between the periods.

From the perspective of location, the analysis was conducted at the global and European levels. At the global level, only the three most important economies were examined: China, the USA, and Europe (including Russia). It is necessary

to remark that according to the source database (UNCTADSTAT, 2020), this trio are the creators of roughly 90% of the digital economy's volume for the entire period of 2009 to 2018.

Europe is further analyzed at the level of the main regions (macroregions), divided according to the classification used by the CIA World Factbook (2020), see Table 1. This classification was chosen because the aim is to affect not only EU countries, but processes across all the Europe. Nonetheless, because of an absence of data, Iceland, the Netherlands, and Spain have not been included in the analysis.

T a b l e 1

European Macroregions

Balkans	**Central Europe**	**Eastern Europe**	**Northern Europe**	**Southern Europe**	**Western Europe**
Albania	Austria	Belarus	Denmark	Cyprus	Belgium
Bosnia and Herzegovina	Czechia	Estonia	Finland	Greece	Faroe Islands
Bulgaria	Germany	Latvia	Norway	Italy	France
Croatia	Hungary	Lithuania	Sweden	Malta	Ireland
Montenegro	Poland	Moldova	Iceland*	Portugal	Luxembourg
North Macedonia	Slovakia	Russia		Spain*	Switzerland, Liechtenstein
Romania	Slovenia	Ukraine			United Kingdom
Serbia					Netherlands*

Note: * Not involved into the assessment.

Source: Own processing based on CIA (2020).

This classification was chosen because of its relatively balanced nature, both in the number of countries included in the individual macroregions, but also due to its general suitability with regards to differentiation in the cultural environments and the cohesion of supply and demand chains. However, its employment brings some limitations. Consider specifically the region of Eastern Europe, where the digitally mature Estonia is grouped together with "analogy" economics like Belarus and Moldova, one can expect higher level of bias in the results and conclusions.

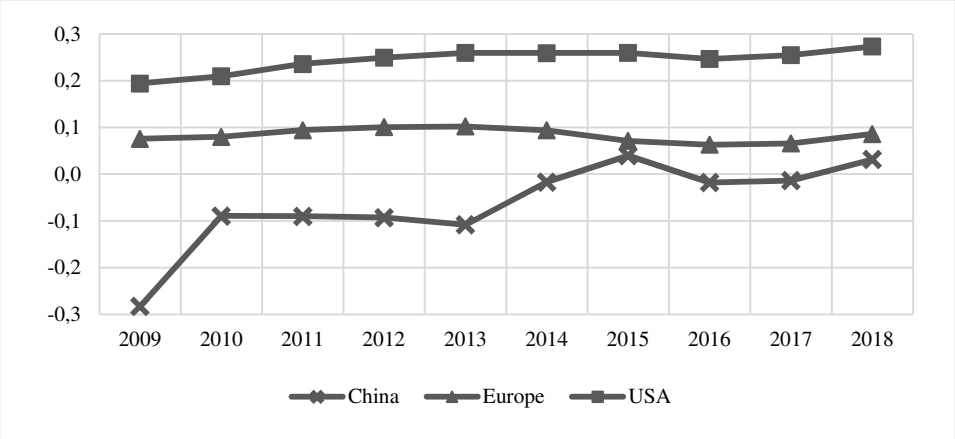
Likewise, the analysis offers at least a partial view into the components contributing to the development of the digital economy in individual European countries, thereby simultaneously contributing to understanding the trends revealed at the level of both Europe and its macroregions. Within the framework of this paper, this part of the analysis, however, is only informative in a supplementary way; its interpretation is limited to conveying basic findings. However, it is significant from the perspective of its conclusions, and it can work as a guidepost for future directions of this research.

3. RCA Analysis Results at the Global Level

The first perspective compares the position of Europe to the two largest global economies, the USA and China, as this concerns the digital economy's RCA – see Figure 1. The USA continually achieved positive values that exceeded Europe's positive values two times over. While RCA values for both these economies grew steadily until 2013, afterwards there was a subsequent drop. Up until 2018, the USA surpassed the value it achieved in 2013. Although Europe succeeded in turning around a decreasing trend in 2018, it did not reach its 2013 value. In both cases, however, this indicates a common evolutionary trend, because based on the Mann-Whitney U test, it cannot be said that the development for the periods of 2009 to 2013 and 2014 to 2018 differ significantly at a significance level of $\alpha = 0.05$. Using a lower level of reliability for this test ($\alpha = 0.10$), however, it can be said that for the period of 2014 to 2018, Europe's developmental trend turned around, from increasing to decreasing.

Figure 1

Comparison of the Development of the Digital Economy's RCA in China, Europe, and the USA for 2009 – 2018



Source: Own processing based on UNCTAD (2020).

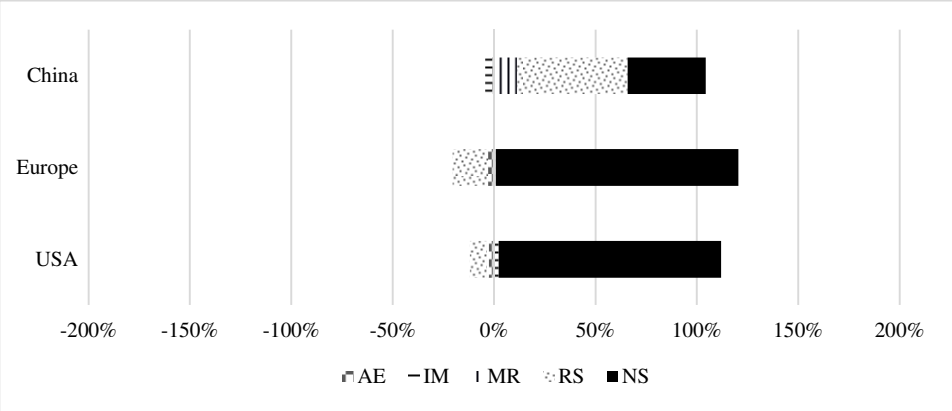
China recorded markedly different development for this period, in which the trends for 2009 to 2013 and 2014 to 2018 differed significantly ($\alpha = 0.05$) and RCA ranged in negative values, with the exception of 2015 and 2018. Thus, in this case, it is clearly possible to speculate about the potential direct impact of implementing elements of the Fourth Industrial Revolution. At the same time, China strongly attacked the position held by Europe with its positive RCA value for 2015.

Considering the share of net exports of digital services in GDP, this increased by 0.48 percentage points between 2009 and 2018 in China, while only by 0.39 in the USA and by 0.38 in Europe. Moreover, while Europe and the USA achieved similar growth in both measures – GDP of the USA 1.4 times, Europe 1.3 times; net exports of the USA 2.2 times, Europe 1.9 times – GDP of China grew even 2.7 times and net exports of digital services 3.7 times (UNCTAD, 2000), i.e., roughly double.

Conducted with the help of shift-share analysis, the breakdown of factors at a global level (see Figure 2) revealed that the primary cause of China's contrasting development is differences in the effects of regional characteristics (RS). Whereas this digital economy growth component slows things down in Europe and the USA, it has a dominantly positive influence in China. In itself, the RS component reflects regional externalities arising due to the existence of agglomeration, the specifics of the labor market, the availability of sophisticated production inputs, the political environment, etc. – thus, the most fundamental part of regional competitiveness. Similarly, it is possible to point out positive growth stimulus by the component for regional characteristics affecting the sector (MR) in China, which has practically no effect in Europe and the USA. Because it is lesser influenced by global trends (NS), China is relatively independent of the development of both world powers, which explains why their RCA trajectories take different forms (see Figure 1).

F i g u r e 2

Breakdown of Digital Economy Growth in China, Europe, and the USA



Source: Own processing based on UNCTAD (2020).

It is necessary to mention that Europe's exports and imports also encompass – in contrast to the USA and China – individual European countries' reciprocal international trade, which largely and understandably distorts global analysis,

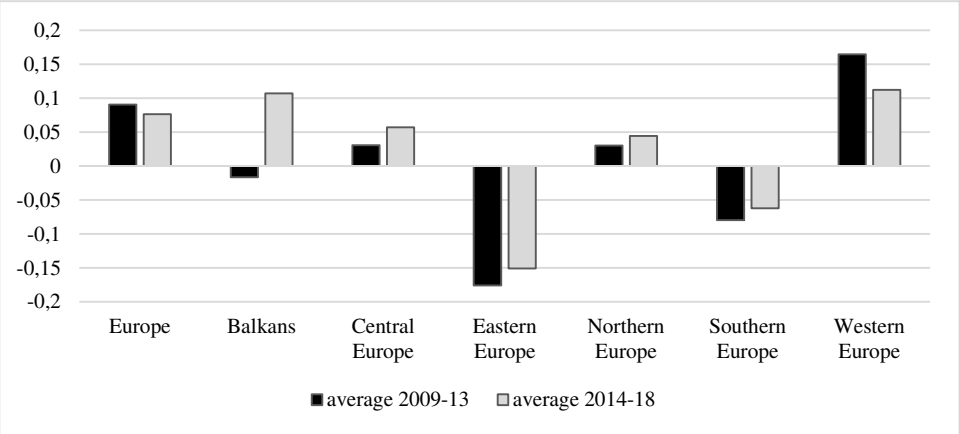
i.e., it increases the Europe's weight within the global economy. At the same time, it is necessary to notice the relative positions of Europe and China during the second period, when China recorded constant RCA growth for its digital economy from 2013 up until a year-to-year drop in 2015/2016, which de facto displaced Europe from its position.

4. RCA Analysis Results at the Level of Europe's Macroregions

Therefore, the change in the digital economy's RCA was analyzed next for both these consecutive five-year periods, i.e., 2009 to 2013 and 2014 to 2018, in Europe and in it's individual macroregions, as depicted in Figure 3.

F i g u r e 3

Changes in the Digital Economy's RCA Level in Europe and Its Macroregions



Source: Own processing based on UNCTAD (2020).

Western Europe did the most towards earning Europe's positive average RCA, with Central and Northern Europe in a far second place. In the first period evaluated, Eastern Europe achieved negative RCA values having absolute values surpassing those of Western Europe, the second largest negative RCA value was reported by Southern Europe, and the Balkans contributed to lowering Europe's overall RCA.

In the following five-year period, Europe's average RCA value decreased. The majority of this was due on one hand to Eastern Europe's ongoing negative RCA value (its absolute value still exceeding that of Western Europe's positive value) plus Southern Europe's negative RCA value and on the other hand, to Europe's RCA being negatively influenced by a decrease in the strongest macro-region, Western Europe. However, definite positive RCA growth in Central and

Northern Europe – in addition to noticeable positive development in the Balkans – contributed to mitigating the drop of Europe's RCA value overall, but was unable to prevent it. It is necessary to mention that from the perspective of these trends' statistical significance, there was significant change only for the macroregions of the Balkans and Central Europe. The other macroregions exhibited gradual evolution; this trend did not undergo significant change over the ten-year period. Otherwise, this conclusion is also valid for RCA development at the European level overall.

For individual years of this decade, Europe's RCA development roughly copied the development of Western Europe, whereas Central Europe's development demonstrated a contrasting tendency: when Western Europe grew, Central Europe weakened (the first five-year period), with the opposite happening after 2013. The recorded correlation coefficient ($\rho = -0.89$), which is significant even at $\alpha = 0.01$, attests to a strong negative correlation between these two macroregions. Northern Europe replaced its growth in the first period with stagnation in the second period. Eastern and Southern Europe retained their negative RCA values, although these improved their unfavorable positions in part. The Balkans showed the most dynamic development, nearly steadily increasing to an RCA value of 0.15 in 2018 up from a RCA value of –0.07 in 2009. From the above, we can deduce four basic patterns of RCA change experienced by Europe's macroregions during the monitored period, as presented in Table 2.

T a b l e 2

The Basic Patterns of RCA Change for Europe's Macroregions

avg. RCA 2009 – 2013	avg. RCA 2014 – 2018	Change	In macroregion
Positive	Positive	Decrease	Western Europe
Positive	Positive	Increase	Central Europe, Nothern Europe
Negative	Positive	Increase	Balkans
Negative	Negative	Increase	Eastern Europe, Southern Europe

Note: avg. = average.

Source: Own processing based on UNCTAD (2020).

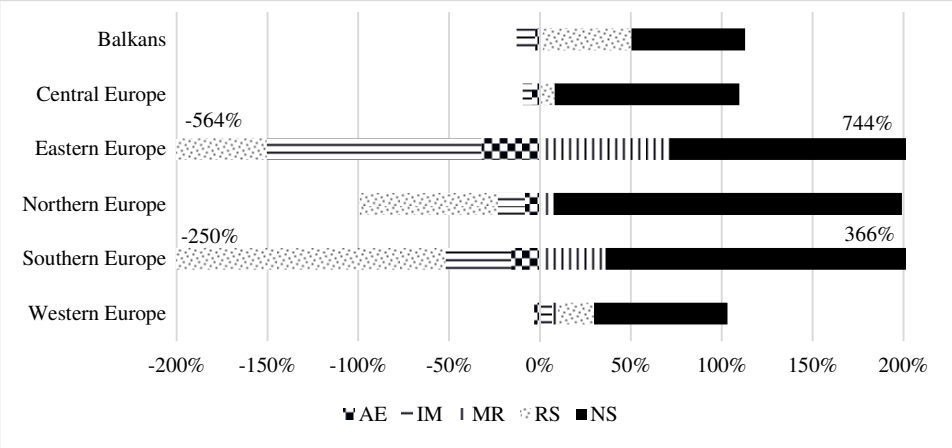
Only Western Europe showed the same type of change, i.e., a decrease, as Europe overall, which testifies to its strong position in the digital economy. The trend for all the other macroregions is an increasing one, with the difference being the average RCA for both periods – whether it stays in the positive range (Central and Northern Europe) or negative range (Eastern and Southern Europe) or even shows a change from negative to positive RCA values (the Balkans).

The shift-share analysis results, conducted using MFP at the level of the main European regions, are depicted in Figure 4. They show that in all cases, the dominant component is the factor of NS, indicating the positive influence of the

higher-level region, i.e., the economy of Europe. Additionally, they show that the components of the digital economy's development differ fundamentally in other respects among the macroregions. Deviation from this is mainly seen for the macroregions with continuously negative RCA, i.e., Eastern and Southern Europe, where the influence of the NS component surpasses the value recorded for the other macroregions. Moreover, these macroregions typically are very negatively influenced by general regional characteristics (RS), but they also show substantial negative influence by sector development (IM) and sector allocation (AE). Here, the digital economy sector specifically lags behind the development level that can be considered standard for this sector, which could also relate to negative influence by AE, which signals that the barrier to the digital economy's development in Eastern and Southern Europe is its share of allocation. Conversely, the MR component's considerable influence is also noticeable here, i.e., regional characteristics positively affecting only the digital economy sector. Therefore, to a certain degree, the MR component balances out the barriers related to negative influences on the sector's development, but it is also worth noting that this component's influence is practically inconsequential for the other macroregions.

F i g u r e 4

Breakdown of Digital Economy Growth in European Macroregions



Note: The numbers reported for some variables represent values beyond the visible graph field (this is also used below).

Source: Own processing based on UNCTAD (2020).

From the perspective of structure, both macroregions partially resemble Northern Europe, although they differ in that the factors' effect is essentially less intense. Despite the fact that RCA values for Northern Europe are positive in both periods, they are relatively low and growth between the periods was just

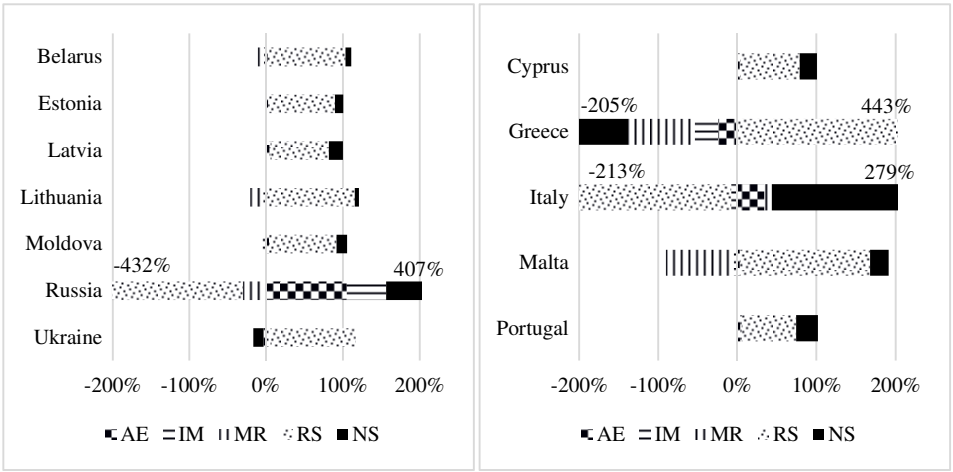
minimal. However, the structure of the components for the remaining regions can be considered entirely different from the previous ones but similar to each other. For the Balkans and Central Europe, RCA grew significantly (at $\alpha = 0.05$) and it was relatively high for Western Europe. Besides the previously mentioned, generally dominant influence of NS, it is also possible to point out RS's positive influence in the Balkans, only a little smaller than NS's influence; Western Europe also recorded a somewhat higher RS value. The influence of the other components is minimal. It is also necessary to point out the structure of factors for Central Europe, where practically 100% of the digital economy's development is the factor of the NS component, thus the European economy's overall development, while the effect of other factors is minimal here.

5. Components of RCA Development at the European Country Level

With regards to the RCA indicator's construction and the shift-share analysis, it is necessary to take into consideration the size and growth factors of the economies to which these macroregions belong. Therefore, the analysis was expanded to the level of individual countries.

Figure 5

Breakdown of Digital Economy Growth in Eastern Europe and Southern Europe



Source: Own processing based on UNCTAD (2020).

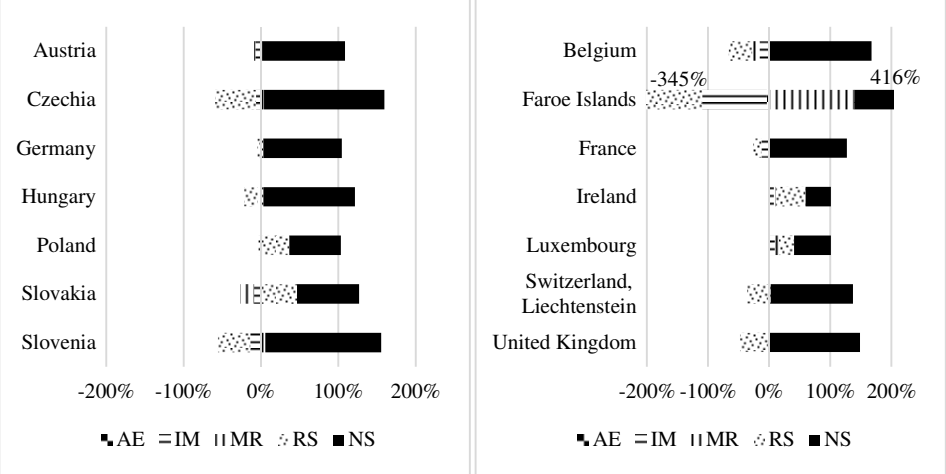
In Figure 5, it is clear that in macroregions with continuously negative RCA, i.e., Eastern and Southern Europe, the growth component structure of their dominant economy differs from that of the other countries in the macroregion. Italy

and Russia (in both cases, they averaged more than 60% of the digital economy's volume in the macroregion for the entire period) are distinguished by rather marked dependence on the development of the digital economy in Europe and also benefit substantially from the sector's allocation in their territory. Conversely, institutional factors expressed in their regional characteristics distinctly slow down their development. For the other countries, the digital economy's growth is spurred on primarily by regional characteristics. In general, however, this concerns universal characteristics (RS). Characteristics coming into play only in the digital economy sector (MR) are not generally too striking and tend to have a negative effect.

It is interesting, however, that in the Central European macroregion – with comparatively dominant Germany – the growth structure between the individual countries does not differ greatly and largely resembles Western Europe's growth structure, which is visible in Figure 6, where the United Kingdom is largest digital economy with 30% of the volume. Both from the perspective of RCA in both the more developed countries of Western Europe and the ones of Central Europe, it generally holds that the NS factor's influence, i.e., external influences arriving from the level of the Europe-wide service economy, is the most important positive growth factor. What has distinctly less influence, despite being the more important component, are regional characteristics (RS); these, however, affect certain countries positively and others negatively. Only the very specific Faroe Islands with utterly inconsequential scope of their digital economy provide an exception to these general conclusions.

F i g u r e 6

Breakdown of Digital Economy Growth in Central Europe and Western Europe

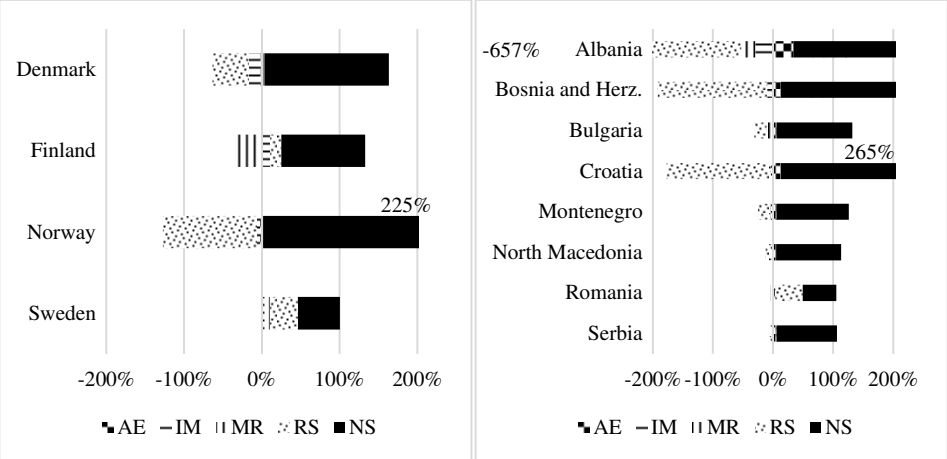


Source: Own processing based on UNCTAD (2020).

Another interesting result is that the countries of the Northern Europe macroregion – whose digital economy growth structure partially resembles the structure of the macroregions with negative RCA, i.e., Eastern and Southern Europe – have a growth structure conversely tending towards that of the Western and Central European macroregions. Only Norway significantly differs in this respect. As is further visible in Figure 7, the most complicated situation is that of the Balkan countries, which recorded the largest boom in RCA (see Figure 3). Most of the countries recorded a growth component structure that tended to be similar to the Western/Central/Northern European models, although Albania, Bosnia-Herzegovina, and Croatia were rather far from this model, for example. Even relatively dominant Romania differs in part (in 2009 to 2018, it averaged 35% of the Balkans' digital economy volume). Here, a more significant positive influence was recorded on behalf of institutional factors, which are expressed by the regional characteristics component (RS). Also of note is that certain Balkan countries are partially influenced by their share of the digital economy's allocation (AE). Conversely, this fact actually reflects the Eastern-Southern European growth model instead.

F i g u r e 7

Breakdown of Digital Economy Growth in Northern Europe and Balkans



Source: Own processing based on UNCTAD (2020).

6. Discussion

The answer to the first research question clearly shows that China has been overtaking the European digital economy's position. At the same time, it is clear that factors have a similar effect in Europe and the USA, in contrast to China's

RCA development being determined in a markedly different way. In Europe and the USA, RCA values are distinctly influenced by global development in a positive way, whereas regional characteristics conversely influence the economy in a negative way. In China, these two components both have positive impact, with regional characteristics in fact having greater weight. Moreover, regional characteristics affecting only the area of digital services improve how China's RCA position is evolving. Thus, Europe's digital economy RCA is decreasing at the start of the Fourth Industrial Revolution, which is a very undesirable phenomenon for digital competitiveness as well as the European economy's competitiveness overall.

Considering the second research question, it should be pointed out that Europe's regional aspects have been shown to be an important negative cause of this development, with these regions exhibiting four different models of how RCA changes. The results of the analysis show a shift of digitally provided services from the west of Europe to its southern and eastern parts. The processes described thus wipe away regional differences in the area of the digital economy and support convergence. However, it is necessary to critically emphasize that this is generally not growth convergence, but convergence between European regions leading to a deteriorating ranking for Europe on the global scale.

From the perspective of breaking down RCA development, shift-share analysis revealed the development of the European economy as a whole was the dominant influence on all macroregions. In other regards, however, there are fundamental differences between the macroregions. With continually negative RCA, Eastern and Southern Europe are primarily set apart, demonstrating active negative influence by general regional characteristics, insufficient growth across sectors, and the scope of the digital economy's allocation for both macroregions. Conversely, regional characteristics linked only to the digital economy sector have a positive effect. Analogous conclusions, albeit with the affecting factors at a lower intensity, are then also valid for the region of Northern Europe. From the perspective of breaking down the factors' effect, the macroregions of the Balkans, Central Europe, and Western Europe are also similar to one another, although quite different from the previous macroregions. Here, the regional characteristics in fact have a diminished effect, though they do strengthen RCA.

In response to the third research question, concerning the influence of factors on the RCA of digital services in particular countries, the analysis suggests: (I) The development of the European economy as a whole (NS) has a positive effect on national digital economies, but this is not the case of Greece and Ukraine. (II) Individual countries are strongly influenced by their regional specifics (RS); however, only about half of the countries are impacted positively (e.g. Greece), while the others examined negative impacts (e.g. Russia and Italy).

(III) The remaining three components – allocation (AE), sector mix (IM), and sector/region interaction (MR) show a lower intensity of influence in both positive and negative direction.

Conclusions

Regarding the growing importance of digitization, it was this paper's goal to evaluate both how the positioning of the digital economy of Europe and its macroregions has been developing over the past decade and to map how strongly selected factors influence these changes. To achieve this goal, evaluation was conducted using the method of RCA in combination with in-depth analysis by MFP, a shift-share analysis modification. Research for the period of 2009 to 2018 was primarily conducted at the level of the main European macroregions. Besides this issue is very topical, the empirical studies usually focus on different aspects than dynamic of factors of competitiveness in relation to the digital economy's development within the main European regions and countries. Therefore, this study seeks to fill this niche, although the results and conclusions are limited by the absence of similar studies with which they could be discussed.

It can be said that global influences contribute the most to the competitive advantage held by the digital economy of Europe's macroregions and countries, thus working as an exogenous growth factor for competitiveness; however, their impact does not have encouraging results for Europe. Secondarily, the economies' competitiveness is influenced by regional characteristics that act across all industries. Conversely, these can be considered purely endogenous factors, because they can be influenced by the institutional framework. The area of institutionalized undergirding and support of the digital economy's development should therefore be a subject of interest for European and national representatives.

Finally, emphasis on endogenous growth factors produces the need to add depth to the presented research by adding detailed analysis of individual macroregion's development at the country level for the purposes of correctly targeting potential tools to support the development of Europe's digital economy. The lack of preparedness of the institutional framework for the digital economy was highlighted by the COVID-19 pandemic. In a number of countries, specific examples of shortcomings were particularly evident in the areas of labor law, (non)preparedness of authorities and schools for electronic communication or robustness of data networks. On the one hand, the pandemic showed current shortcomings and also highlighted existing differences, but on the other hand, it also underlined the importance of digitization and considerably accelerated this process in many productions and services.

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