TELEWORK – A MODERN FORM OF ECONOMIC RESILIENCE IN KNOWLEDGE-BASED SOCIETIES

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Abstract
In knowledge-based societies, adapting to constantly changing economic environments pushes companies and institutions to create, co-create or acquire knowledge. The objective of this research was to investigate telework as a modern form of economic resilience in knowledge-based societies by carrying out a statistical analysis on the GDP composition in the case of the EU-27 members and then connect the results with statistical data concerning teleworking and intelligent device usage at work, based on the double dendrograms – clustered heat maps method. In this paper, the economic structure of the EU-27 members was put in the spotlight of the research, emphasizing that rapid efficient responsiveness to knowledge-driven change is one of vectors that consolidate a modern form of economic resilience. In Europe, teleworking has been continuously evolving since its emergence as a modern form of labour and economic resilience, yet it is far from reaching its full potential. Results show that the information and communication sectors from Ireland, Cyprus, Sweden and Malta favour teleworking as a form of economic resilience. This research proves the opportunity for fostering telework as an efficient instrument to enhance economic resilience.

Keywords: telework; GDP composition; economics of resilience; knowledge economy.
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Introduction

The process of adopting new information and communication technologies (ICTs), together with the emergence of efficient working methodologies and procedures, do not occur spontaneously, let alone if no effort and resources are allocated in this regard. At the beginning of 2021, the global socio-economic momentum is marked by the global capitalism, the open labour market (especially in the digital space), social and networking platforms. Although the effects of the COVID-19 pandemic might not have had a significant impact on evolution of technologies such as the blockchain or the Internet of Things (IoT), the effects of the pandemic have been significant on the well-being and mental health of employees, yet in many directions, both positive and negative.

The well-being and mental health of employees is an ardent issue highly approached in the literature, from multiple perspective: in relation with the telecommunication technology–

financial costs–government policy nexus (Johnson et al., 2020), from the perspective of heavy work investments and their economic implications (Pătărlăgeanu et al., 2020), as well as from the perspective of mitigating sanitary risks at the workplace (Ahmed, Zviedrite and Uzicanin, 2018).

Multinational companies, SMEs and even public institutions are constantly and heavily investing resources in the process of implementing new performant technologies with the aim of exploiting benefits – socio-economic preponderantly (Silva, Montoya and Valencia, 2019), guided by innovation. Not only is innovation changing socio-economic realities progressively, but also, along with creativity and technology, this mix of factors acts as the main vector of economic growth and evolution in knowledge-based societies. Moreover, the literature contains relevant studies concerning the role of innovation in relation with mitigating socio-economic, climate, environmental risks (Hurduzeu and Popescu, 2015; Curran, 2018; Banacu et al., 2019; Andrei et al., 2021).

At the end of the second millennium, Ruppel and Harrington (1995) anticipated the emergence of a new form of innovation based on technology leaps – teleworking. In their paper, the authors argued that telework is well-fitted into the innovation theory framework, in the benefit of both the employees and organizations. Only two decades later, this relation expanded beyond the organization–employee framework and intentionally included home-based internet-driven business models harnessed by individuals with a well-developed entrepreneurial and innovative spirit (Domenico, Daniel and Nunan, 2014).

In this new digital-oriented economic paradigm, individuals and technology have led society on its path to reshape knowledge as one of the main factors that significantly contribute to consolidating economic positions globally (Huggins and Izushi, 2009).

In spite of a universally accepted definition of telework, the literature consists of paper referring to teleworking as the work or service-oriented activities carried out at distance, remotely, outside employer's locations. Work is conducted through information and communication technologies (ICTs), facilitating working from many places: home, shared public spaces, customer sites, holiday resorts etc. (Di Martino and Wirth, 1990; Raghuram, 1996; Messenger and Gschwind, 2016; Boell, Cecez-Kecmanovic and Campbell, 2016).

Telework has been briefly approached as a form of economic resilience in the literature. In the context of the COVID-19 pandemic, Zamfir and Aldea (2020) argued that labour markets and numerous sectors and economic activities had to suffer, except those highly digitized that facilitated teleworking. The COVID-19 outbreak has put telework into the spotlight of labour instruments, pushing decision makers to adopt measures designed to promote and improve telework ability as a form of resilience in the face of the COVID-induced labour market working crisis.

As far as resilience is concerned, it is a term used to describe and assess how an entity or system responds to shocks and disturbances, such as the one caused by the effects of the COVID-19 pandemic. Since economic resilience is a complex process, Pontarollo and Serpieri (2020) constructed a composite tool that can be used to monitor the socio-economic implications of resilience through the lens of spatial and cluster analyses at the level of the EU-27, based on contribution of economic sectors: non-competitive, stale and rigid GDP compositions are subject to poor economic resilience.

Beyond the generally accepted statements concerning economic resilience, there is still a much broader and comprehensive scheme regarding both the intension and extension of the "economic resilience" notion (Simmie and Martin, 2010). Păunescu and Mátyus (2020) approached economic resilience in relation with the development potential of digital technologies in knowledge-based societies, arguing that technology advances push companies to rethink business models and managerial processes. Moreover, the same authors

suggest that teleworking and flexible, cost-efficient systems deliver operational performance, reflected in the composition of national economies.
Taking all these factors into account, the objective of this research was to explore telework as a modern form of economic resilience in knowledge-based societies by carrying out a statistical analysis on the GDP composition in the case of the EU-27 members and then map the results with statistical data concerning teleworking and intelligent device usage at work, based on the double dendrograms – clustered heat maps procedure.

1. Literature review

Teleworking is a relatively new concept that can be characterized based on multiple dimensions: (a) workplace – referring to the fact that work can be performed regardless of a specific constant location and individuals work remotely: from home, hotels, public access spaces such as coffee shops (Lachapelle, Tanguay and Neumark-Gaudet, 2018); (b) information and communication technologies – referring to the technical infrastructure and instruments needed in the digital space for individuals to communicate and carry out operational and managerial activities (Wellman et al., 1996; Raghuram, Wiesenfeld and Garud, 2003); (c) the legal factor – regulations are still lacking in some parts of the world and the absence of a well-established regulatory teleworking framework negatively impacted the diffusion and implementation of generally accepted teleworking practices (Belzunegui-Eraso and Erro-Garcés, 2020).
The benefits of remote working are numerous: it facilitates flexibility for both the employer and employee (Dimitrova, 2003); it empowers a strong and equitable work–family balance (Kossek, Lautsch and Eaton, 2006), while reducing the environmental impacts of mobility (Fu et al., 2012). Despite all these benefits, the implementation of teleworking practices across Europe, especially home-based remote working, has been moving slowly even before the COVID-19 crisis (Belzunegui-Eraso and Erro-Garcés, 2020).
Gajendran and Harrison (2007) demonstrated that home-oriented teleworking contributed to the mitigation of the work–family conflict, although it led to a decrease in the relationship quality between co-workers. On the bright side, high-intensity teleworkers had success in reducing role stress. Moreover, the authors stress that perceived autonomy is critical for obtaining maximal beneficial outcomes.
Dima et al. (2019) put the sustainability factor in the spotlight of their research concerning the social implications of teleworking, arguing that remote working itself allows easy access into the international labour market in the case of some economic sectors and only for particular socio-professional categories, otherwise disadvantaged (communities living in rural areas, mothers with new-born children etc.).
Taskin and Bridoux (2010) explored the early stages of knowledge-based societies and focused on the knowledge transfer process between teleworking individuals and those non-teleworking, highlighting that relational and cognitive aspects of socialization might be negatively affected in organizations due to teleworking.
In modern societies driven by innovation and collaboration, teleworkers are also called knowledge works (Ng, 2016). In such economies, they are encouraged to transfer knowledge – this can take place even in public and semi-public spaces with favourable ambient conditions and good internet connectivity. The transition to this form of doing business and conducting work has been described even in early studies, such as the one of carried out by Bentley and Yoong (2000).
In context of the COVID-19 pandemic, officially declared in March 2020 (World Health Organization, 2020), many studies were elaborated on the topic of teleworking and its bright potential in the context of the restrictions implemented as a means to obtain physical

distancing and stop the virus from spreading. In this regard, some governments recommended teleworking as a mean for employees to avoid gathering together in the same working place (Kawashima et al., 2021).

In their paper, Bolisani et al. (2020) argued that knowledge transfer and management have become more important than before due to the COVID-19 outbreak, which pushed the limits of the traditional framework of approaching the nature of work. However, the literature is not rich on papers approaching the implications of the GDP composition as a factor that influences the adopting of teleworking as a solution to overcome moments of crisis. Moreover, there is a gap in the literature regarding the GDP composition–telework–intelligent device usage nexus, as a factor that can increase economic resilience.

This paper expands and complements the existing literature concerning telework with a unique perspective on the relation between technology leaps and telework's potential for becoming an even stronger form of economic resilience in knowledge-based societies. By tapping into the GDP composition of the EU-27 members, this subject is connected in this paper with the statistics of telework and intelligent device adoption rate. In the same regard, this paper brings its contribution to the literature with the quantitative analysis concerning convergence and divergence points in the case of the EU-27 members.

2. Research Methodology

Data used to carry out this research were gathered from the Eurostat. The first part of this research involved statistically analysing the gross value added by economic sector breakdown in the EU-27. The same quantitave approach was respected when tackling the economic sector breakdown by country. Additional attention was paid to the most significant changes observed at a ten years interval at the level of economic sector breakdowns by country. Since the agricultural economy was followed by the industrial economy and then by the knowledge economy (LaFayette et al., 2019), the literature is rich on papers approaching the nature of knowledge-based economy through the lens of the ICT–agriculture socio-economic paradigm changes (Koski and Ylä-Anttila, 2006; Avkopashvili et al., 2019; Fait et al., 2019). Taking this into account, the statistical analysis carried out in this research was also focused on exploring a potential paradigm shifts in the EU-27 through the prism of the ICT–agriculture sector dynamics.

Initial research results were connected to telework-specific statistical data by designing three-dimensional surface plots based on the EU-27 individuals who: (a) practiced teleworking; (b) used computers, laptops, smartphones, tablets or other portable devices at work; (a) and (b) at country level, in relation with the contribution of each EU-27 member to the generation of the EU-27's total GDP. Moreover, the double dendrograms: clustered heat maps method was applied to the statistical data concerning teleworking, intelligent device usage at work, and as well as to some of the data referring to the economic structure of the EU-27 members. The purpose of using this method was to hierarchically design clusters in two directions: one referring to the EU-27 countries, while the other is specific to the indicators previously mentioned. This clustering method implies that, systematically, the two clusters that are most similar are joined together into a single brand-new cluster – repeatedly until all the indicators and countries were joined. The single linkage (nearest neighbour) clustering method was used, based on the Euclidean distance type. Moreover, the cophenetic correlation coefficient was calculated. It refers to the original raw and variable distances and to those that result from cluster mapping, in relation with specific hierarchical configurations. A value of 0.75 or above is considered optimal for the clustering analysis to be considered meaningful (Holgersson, 1978). Another measure of clustering goodness of fit that was performed in this research was carried out based on equation (1) – the delta coefficient, as described by Mather

(1976). This test tracks the distortion levels, rather than those of resemblance (differently than the cophenetic correlation). Delta coefficients are calculated as it follows:

$$\Delta_A = \left[\frac{\sum_{j<k}^{N} \left| d_{jk} - d^*_{jk} \right|^{1/A}}{\sum_{j<k} \left(d^*_{jk} \right)^{1/A}} \right]^A$$

Regarding equation (1): A can take the form of either 1 or 0.5 and d^*_{jk} represents the cophenetic distance resulted based on the cluster configuration. For cluster validation, values as close to zero are desirable, as well as configurations with the smallest delta value, as it indicates the good fit of data. Variable and raw data were double-scaled based on the Z-scores method, frequently used to transform and standardize data for clustering purposes (Mohamad and Usman, 2013).

3. Results and discussions

The evolution of the gross value added at the EU-27 level by economic sector breakdown shows that no major shifts occurred during the 2008-2018 period, as one can notice from Figure 1. The greatest standard deviation was recorded in the case of industry and construction sector (0.45% and 0.41%) and the most resilient sector to economic paradigm changes was the sector specific to arts, entertainment, recreation and other service-oriented activities – with a standard deviation of only 0.06%. The ICT sector's contribution to the EU-27's total gross value added has remained constant overall at level, as well as the contribution of the agriculture, forestry and fishing sectors, despite the fact that many changes can be observed at a country-level analysis.

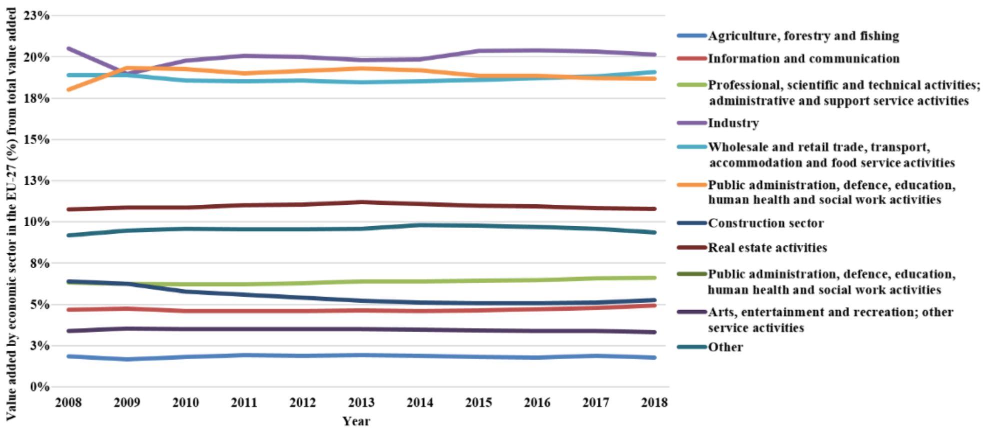

Figure 1. The evolution of the gross value added at the EU-27 level by economic sector breakdown

Source: Authors 'own calculations and representation, based on Eurostat data (2021)

Table 1 contains the gross value added by country breakdown in the EU-27 in the case of the ICT and agriculture, forestry and fishing sectors, in relation with the share of the value added nationally from the total value added at EU-27 level. The full transition to the knowledge economy is a long and complex process that involves reshaping the structure of economy, making it more resilient to emerging threats. However, this transition is creating its unique set of disruptions, as some countries manage to adapt faster and more efficiently to new technologies and working/teleworking conditions than other countries. Despite the fact that the economic sector breakdown does not show major change during a ten years interval (2008-2018) in the case of the EU-27 as a whole (see Figure 1), data confirm otherwise in the case of individual EU-27 members. For example, although Ireland has a small contribution to EU-27's value added from all economic sectors, its ICT sector is the most developed in the EU-27, as it represented 12.74% of the total value added by all Irish economic sectors in 2018. This signals an increase of the national Irish economic resilience and adaptive potential to shocks, such as the one caused by the novel coronavirus pandemic and its effects on the working conditions. On the other hand, Greece has registered the greatest losses of the ICT sector's share from the total value added by all Greek economic sectors; while the agriculture, forestry and fishing sectors registered the greatest share increases from the total value added by all Greek economic sectors. These results show that the Greek economy is encountering issues in the transition to the knowledge economy. Based on the ICT–agriculture, forestry and fishing sector relation, the Greek economy is prone to being less resilient, especially in comparison with the Irish economy. These results are also convergent with Hadad's (2018) findings. Based on data from Table 1, Slovenia is in a similar situation to that of Greece's, while Cyprus and Malta follow Ireland's development patterns of the national knowledge economy.

Table 1. The share of the value added nationally by economic sector from the total value added at the level of all national economic sectors

Sector & Year / Country	The share of the value added nationally from the total value added at EU-27 level			Economic sectors: agriculture, forestry and fishing			Economic sectors: information and communication		
	2008	2013	2018	2008	2013	2018	2008	2013	2018
Belgium	3.16%	3.40%	3.40%	0.80%	0.76%	0.63%	4.12%	4.17%	4.29%
Bulgaria	0.31%	0.35%	0.40%	6.98%	5.21%	3.89%	5.81%	5.66%	6.79%
Czechia	1.48%	1.38%	1.57%	2.12%	2.64%	2.15%	5.15%	5.08%	5.83%
Denmark	2.08%	2.17%	2.17%	1.00%	1.51%	1.20%	4.53%	4.69%	4.58%
Germany	23.02%	24.49%	25.03%	0.93%	1.05%	0.74%	4.64%	4.70%	4.81%
Estonia	0.15%	0.16%	0.19%	3.81%	3.50%	2.19%	4.94%	5.09%	6.29%
Ireland	1.69%	1.59%	2.55%	0.95%	1.18%	0.94%	7.60%	10.23%	12.74%
Greece	2.15%	1.54%	1.29%	3.18%	3.82%	4.22%	3.77%	3.06%	3.20%
Spain	10.28%	9.03%	9.02%	2.57%	2.87%	3.05%	4.00%	3.89%	3.80%
France	18.03%	18.41%	17.37%	1.68%	1.63%	1.86%	5.24%	4.90%	5.29%
Croatia	0.41%	0.35%	0.35%	4.65%	4.20%	3.65%	4.98%	4.80%	4.93%
Italy	14.86%	14.06%	13.15%	2.08%	2.38%	2.17%	4.13%	3.69%	3.76%
Cyprus	0.17%	0.15%	0.15%	2.42%	2.30%	1.96%	3.39%	4.28%	6.45%
Latvia	0.22%	0.20%	0.21%	3.28%	3.63%	4.14%	3.88%	4.49%	5.53%
Lithuania	0.29%	0.31%	0.34%	3.66%	3.91%	3.20%	3.36%	3.23%	3.72%

Luxembourg	0.34%	0.40%	0.45%	0.35%	0.31%	0.25%	5.85%	5.82%	7.19%
Hungary	0.93%	0.83%	0.95%	4.04%	4.65%	4.09%	5.35%	5.28%	4.90%
Malta	0.05%	0.07%	0.09%	1.20%	1.21%	0.85%	5.24%	5.31%	6.97%
Netherlands	5.82%	5.77%	5.73%	1.83%	1.99%	1.84%	5.03%	4.67%	4.99%
Austria	2.64%	2.80%	2.85%	1.50%	1.41%	1.27%	3.33%	3.40%	3.74%
Poland	3.21%	3.37%	3.61%	2.97%	3.48%	2.67%	4.28%	3.87%	4.26%
Portugal	1.57%	1.45%	1.47%	2.25%	2.38%	2.35%	3.83%	3.49%	3.52%
Romania	1.32%	1.23%	1.53%	7.03%	6.10%	4.79%	4.83%	5.77%	5.89%
Slovenia	0.33%	0.31%	0.33%	2.09%	2.28%	2.58%	4.01%	4.19%	3.86%
Slovakia	0.60%	0.65%	0.66%	2.81%	3.02%	2.66%	4.37%	4.68%	4.62%
Finland	1.72%	1.71%	1.67%	2.51%	2.75%	2.76%	4.81%	5.31%	5.89%
Sweden	3.16%	3.80%	3.45%	1.77%	1.65%	1.57%	6.70%	7.45%	7.58%

Source: Authors 'own calculations, based on Eurostat raw data (2021)

These findings are furthermore confirmed by the data included in Table 2, referring to most significant changes (2018 reported to 2008) at the level of national economic sector breakdown. Based on Table 2 data, Bulgaria is successfully transitioning to a more resilient knowledge-based economy, if considering that the agriculture, forestry and fishing sectors registered the greatest share loss: 3.09% from the total national value added from all Bulgarian economic sectors.

Table 2. Economic sectors breakdown – Most significant changes (2018 reported to 2008) by country

Sector breakdown	Share of sector value added from the total generated in the EU-27		Average Share Growth (EU-27, 2018 vs 2008)	Maximum share gain (2018 vs 2008)				Maximum share loss (2018 vs 2008)			
				Value added – sector share from total (national)			Reported by (Country)	Value added – sector share from total (national)			Reported by (Country)
	2008	2018		2008	2018	Change		2008	2018	Change	
Agriculture, forestry and fishing	1.66%	1.61%	-0.25%	3.18%	4.22%	1.04%	Greece	6.98%	3.89%	-3.09%	Bulgaria
Information and communication	4.19%	4.41%	0.70%	7.60%	12.70%	5.10%	Ireland	3.80%	3.20%	-0.60%	Greece
Professional, scientific and technical activities; administrative and	5.66%	5.91%	0.72%	4.78%	9.25%	4.47%	Malta	6.79%	5.76%	-1.03%	Croatia
Industry	18.41%	18.01%	-0.70%	22.37%	36.53%	14.16%	Ireland	17.28%	10.19%	-7.09%	Malta
Wholesale and retail trade, transport, accommodation and food service	16.95%	17.05%	0.07%	28.12%	31.71%	3.59%	Lithuania	16.25%	11.65%	-4.61%	Ireland
Public administration, defence, education, human health and social work	16.17%	16.69%	0.30%	10.37%	14.96%	4.58%	Romania	17.61%	10.64%	-6.98%	Ireland
Construction	5.74%	4.72%	-2.01%	5.48%	6.71%	1.23%	Sweden	12.27%	5.69%	-6.58%	Cyprus
Real estate	9.64%	9.65%	0.62%	9.40%	12.51%	3.11%	Portugal	8.78%	7.32%	-1.46%	Luxem-bourg
Arts, entertainment and recreation; other service	3.04%	2.99%	-0.65%	4.13%	5.67%	1.54%	Greece	9.63%	4.76%	-4.86%	Malta

Source: Authors ' own conceptualization and calculations, based on Eurostat raw data (2021)

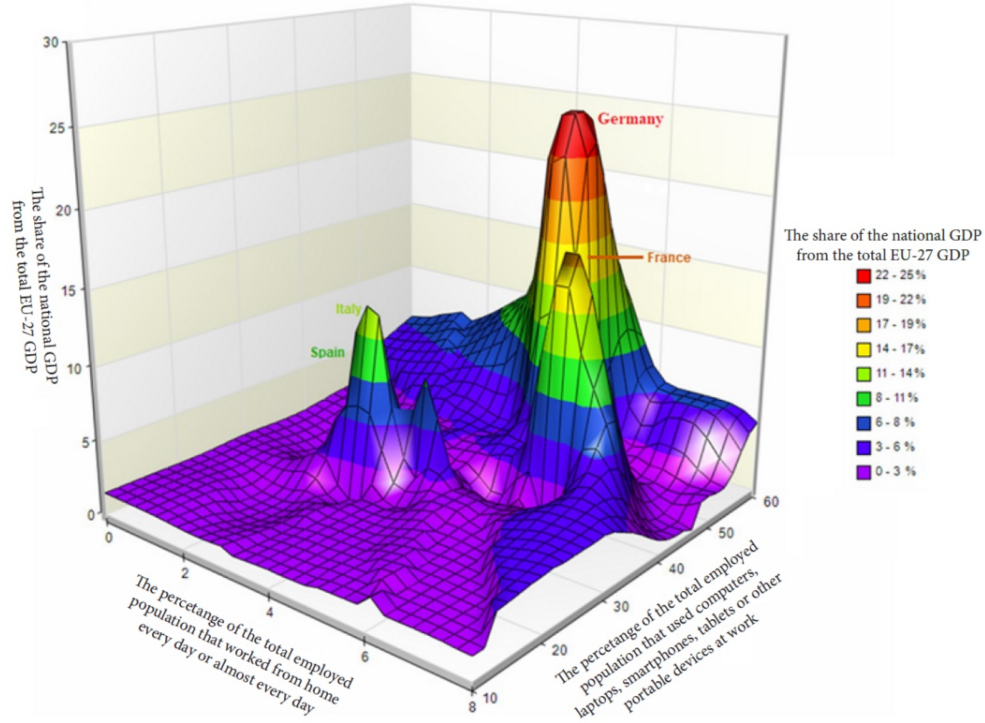

Figure 2. 3D surface plot of (a) the EU-27 individuals who practiced teleworking; (b) the individuals who used computers, laptops, smartphones, tablets or other portable devices at work; (c) the share of the national GDP from the total EU-27 GDP
Source: Authors' own computation

Surface plotting the share of the national GDP from the total EU-27 GDP in relation with indicators specific to telework and intelligent device usage at work show Germany as a European leader due to: (a) its significant share (24.83%) from the total GDP generated in the EU-27; (b) the percentage of the employed population that worked from home every day or almost every day (5%) from the total employed population and (c) the percentage of the employed population that used computers, laptops, smartphones, tablets or other portable devices at work (51%) from the total employed population. Although France surpassed Germany in terms of teleworking (6% compared to 5%), the percentage of the French employed population that used computers, laptops, smartphones, tablets or other portable devices at work from the total was 10 percentage points lower than in the case of Germany (41%) and the contribution of the France to the EU-27's GDP was of 17.46%, the second top contributor after Germany. Closely followed by Italy and Spain (13.10% and 8.91%), these two countries encounter issues in adopting teleworking (3% and 4% adopting rate) and integrating smart device usage at work (32% and 33%, below the EU-27's average of 37.62%). The latter could be a cause of poor teleworking practices in Italy and Spain. Figure 3 is a replica of Figure 2, but Germany, France, Italy and Spain were excluded with the aim of exploring the same relations in case of the countries that registered smaller shares of the national GDP from the total EU-27 GDP.

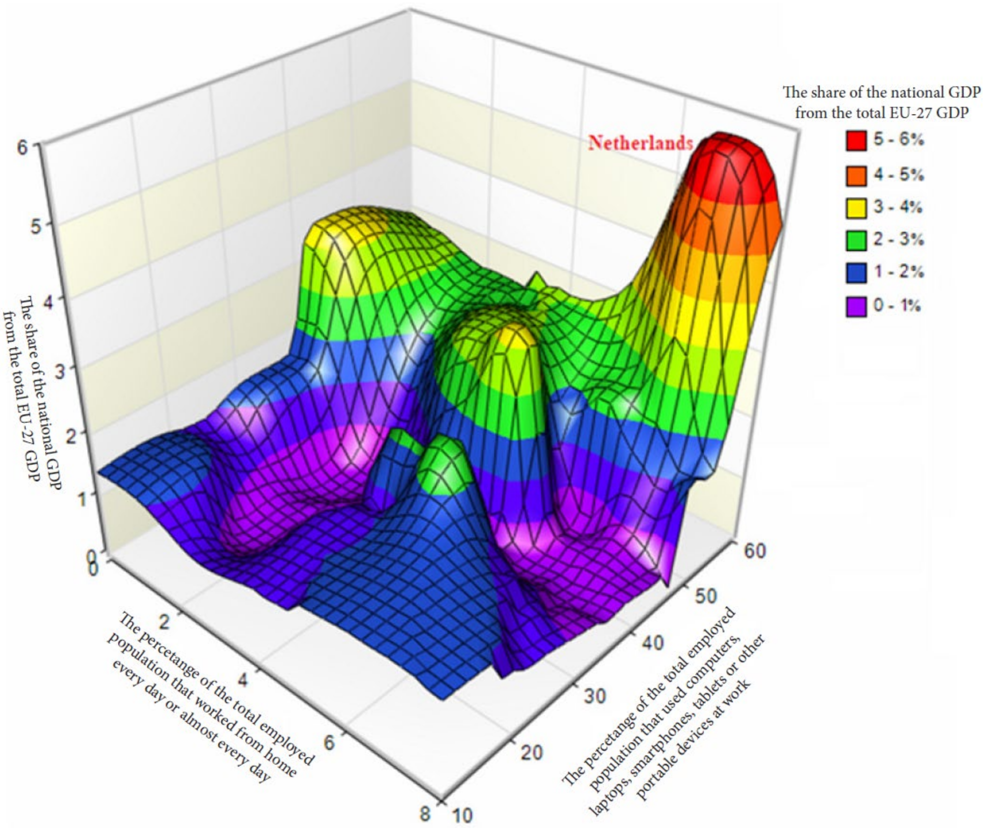

Figure 3. 3D surface plot of (a) the EU-27 individuals who practiced teleworking; (b) the individuals who used computers, laptops, smartphones, tablets or other portable devices at work; (c) the share of the national GDP from the total EU-27 GDP (with the exception of Germany, France, Italy and Spain)
Source: Authors' own computation

By excluding Germany, France, Italy and Spain from the 3D surface plot in Figure 3, one can notice that the Kingdom of the Netherlands is among the European leaders in terms of the nexus of teleworking – intelligent device usage at work – national contribution to the EU-27's GDP. Moreover, the Kingdom of the Netherlands is the first in the EU-27 top regarding the percentage of the employed population that used computers, laptops, smartphones, tablets or other portable devices at work (59%) from the total employed population and, based on the teleworking results (7%), the country is situated on the second place in the EU-27, after Finland, Luxembourg and Malta – they registered a percentage of 8% of the employed population teleworking, yet their national contribution to EU-27's total GDP is not impactful: 1.73%, 0.44% and 0.09%, respectively. The biggest gap in the EU-27 can be observed in the case of Romania, Bulgaria and Cyprus. Romania registered the smallest percentage in the EU-27 as far as the teleworking individuals were concerned: only 1%, followed by Bulgaria and Cyprus: 2%. Moreover, from the perspective of integrating smart device usage at work, Cyprus was slightly below the average (37.62%), lacking 2.62% percentage points, followed by Bulgaria (21%) and Romania (17%). The national contribution of Cyprus to EU-27's GDP was the least impactful: 0.16%, followed by Bulgaria's (0.42%) and Romania's (1.51%).

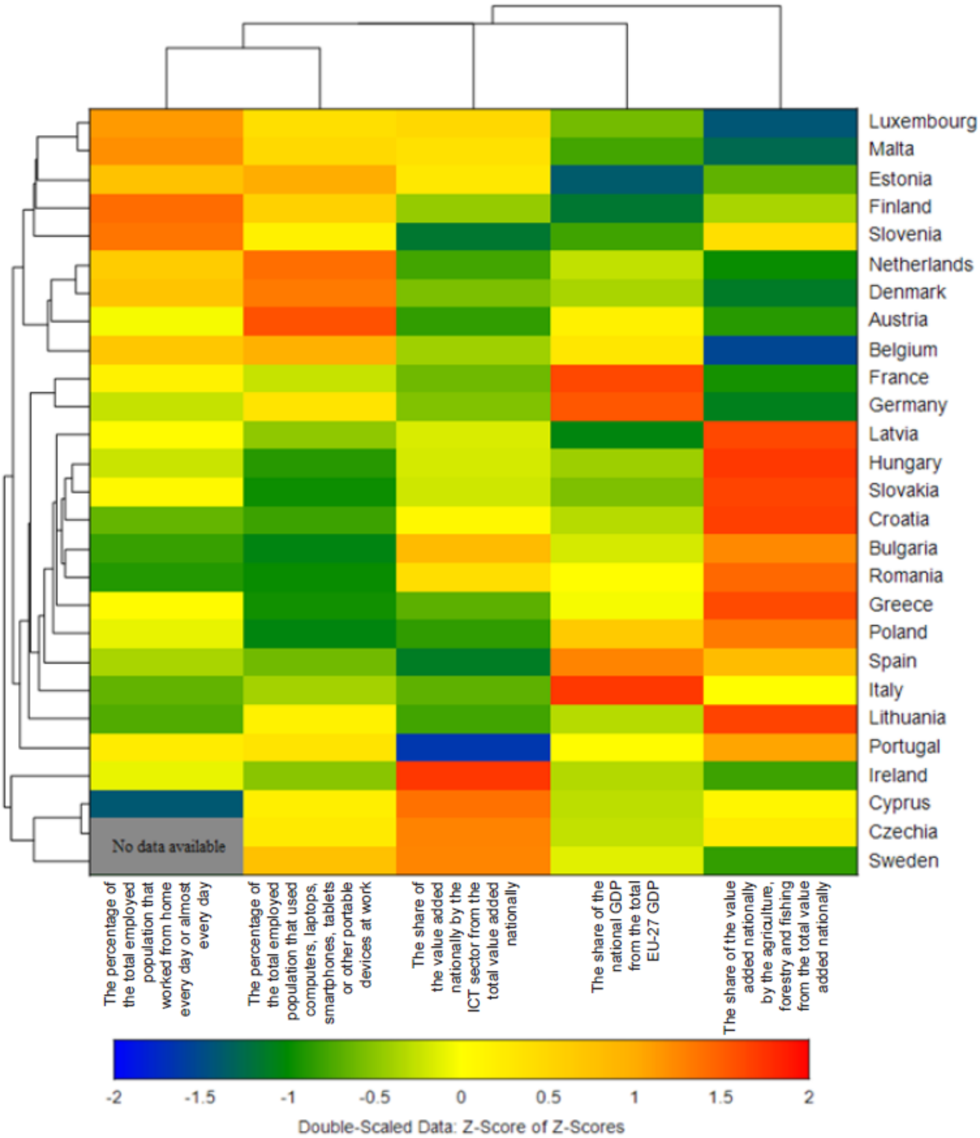

Figure 4. Double dendrograms – clustered heat map of variables and countries
Source: Authors' own computation

Table no 3. Clustering Validation Test

	Clustering Variables
Cophenetic Correlation	0.946639
Delta (1.0)	0.102867
Delta (0.5)	0.064740

Source: Authors' own computation

The clustering – double dendrograms and the clustered heat map from Figure 4 is validated based on the cophenetic correlation coefficient calculated in Table 3: 0.94663, value above the significance threshold of 0.75, considered optimal for this type of quantitative analysis. Regarding Mather's delta coefficients (1976) from Table 3, in order to validate the cluster analysis, values as close to zero are desirable. Clustering results confirm the good fit of data, as the delta coefficients are 0.102867 and 0.064740, close to the desirable zero value.

Regarding teleworking, the cluster centred on best-performing countries contains: Luxembourg, Malta, Estonia, Finland and Slovenia. The effects of implementing policies and measures designed to stimulate teleworking in these countries are visible. Moreover, the generation of this cluster was also caused due to the fact that Luxembourg, Malta, Estonia, Finland and Slovenia – they each have an ICT sector that significantly contributed to the generation of the total added value nationally (these countries registered values above EU-27's average regarding the contribution of the ICT sector to the national added value generated: 5.39%). Additionally, three more similarities of the countries forming this cluster are: (a) low national shares from of the total EU-27 GDP (starting from 0.09% in the case of Malta and reaching a maximum of 1.73% in the case of Finland), (b) above-average intelligent device usage at work (starting from 38% in the case of Slovenia and reaching a maximum of 49% in the case of Finland), (c) average performance regarding the contribution of the agriculture, forestry and fishing sectors to the generation of national.

The cluster containing Latvia, Hungary, Slovakia, Croatia, Bulgaria, Romania, Greece, Poland, Spain, Italy and Lithuania is centred around best-performing countries concerning the contribution of the agriculture, forestry and fishing sectors to the generation of total national added value – this cluster is 1.48 times more performant than in the case of the EU-27's average (2.36%). Despite the fact that this result could hint at high levels of food security in the case of the countries forming this cluster, there are convergence points that characterize this cluster as encountering serious issues in terms of adapting to the new form of modern economies, based on knowledge. In this regard, Latvia, Hungary, Slovakia, Croatia, Bulgaria, Romania, Greece, Poland, Spain, Italy and Lithuania need to improve their strategies concerning the digitization of economic activities, automation and integration of intelligent devices in work-related activities. With the exception of Italy (13.10%) and Spain (8.91%), the countries forming this cluster brought only 1.06% contribution to the generation of EU-27's GDP. Moreover, the contribution of the ICT sector to the generation of the total national added value is slightly below EU-27's average (cluster's average: 4.67% vs EU-27's average: 5.39%).

Ireland, Cyprus, Sweden and Czechia formed a cluster centred on best-performing countries concerning the contribution of ICT sector to the generation of total national added value. To support this, results confirm that the analysed cluster was 1.51 times more performant (8.15% average contribution) than in the case of the EU-27's average (5.39%). Ireland and Sweden were top two EU countries in this regard (the ITC sector contributed to the total national added value with 12.74% and 7.58%). However, it is curious that the percentage of the employed population that used computers, laptops, smartphones, tablets or other portable devices at work was only 37% of the total employed population on average in this cluster, while the EU-27's average was slightly above: 37.62%. Together, the countries forming this cluster share only 7.62% of EU-27's total GDP (Sweden taking the biggest share: 3.48% and Cyprus the smallest: 0.16%).

Conclusions

In this new global digital-oriented economic framework that has acquired new meanings and a much more pronounced impact on the nature of work during the COVID-19 pandemic, through technology and innovation, individuals are leading society on the path to a more economically resilient future.

The findings of this research position Luxembourg, Malta, Estonia, Finland and Slovenia in a cluster of best-performing EU-27 countries as far as telework is concerned. Another cluster – that consisting of Ireland, Cyprus, Sweden and Czechia – is centred on best-performing EU-27 countries regarding the national contribution of the ICT sector to the generation of the national GDP. These two clusters are specific to EU-27 members that harnessed knowledge, technology and innovation as means to consolidate economic resilience at the level of strategic economic sectors. On the other hand, Latvia, Hungary, Slovakia, Croatia, Bulgaria, Romania, Greece, Poland, Spain, Lithuania and Italy formed a cluster specific the European countries transitioning to the knowledge economy model.

The originality/value of this paper refers to the approach on telework – statistically explored as a modern form of economic resilience in knowledge-based societies by looking at the GDP composition in the case of the EU-27 members and map convergence points with the double dendrograms – clustered heat maps procedure.

The limitations of this research come from the nature of data itself – Eurostat telework-related statistical data are not split per economic sector breakdown, which would have facilitated a more in-depth analysis on the resilience at sector-level in relation with the technical and socio-economic implications of the full transition to the knowledge-based economy in the EU-27. When data become available, this statistical research can be expanded in this regard. Moreover, this research can also be expanded with the analysis of the COVID-19 pandemic effects on the telework adoption rate as a modern form of economic resilience in the face of socio-economic crisis generated by the implementation of the sanitary measures designed to limit the rapid spread of the virus.

The full transition to the knowledge-based economy, resilient and highly digitized with teleworking capabilities requires decision makers to completely understand the necessity and opportunity of allocating resources and effort on supporting entrepreneurs develop sustainable business models that have knowledge at the core of initiatives – not only in the ICT economic sector, but in others as well.

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