Digitalisation and Happiness in the European Union

Aurora Murgea
West University of Timisoara,
Faculty of Economics and Business Administration, Romania
aurora.murgea@e-uvt.ro

Abstract

Digitalisation is for sure one of the most pervasive and significant transformations that humanity has undergone in the last decade. Technology changed how we see and relate to the world, the interhuman relationships and represented an essential catalyst for innovation and development. The paper aims to analyse the relationship between digitalisation (overall and its components) and happiness in European countries from 2017-2022 using an OLS naïve panel model and Granger causality. The results show that, overall, digitalisation has a negative impact on happiness. At the same time, Internet user skills, Fixed broadband coverage, Mobile broadband, and E-government seem to be the digitalisation components with the most significant impact on happiness.

Key words: digitalisation, happiness, European policies, future
J.E.L. classification: I15, I31, O11, O38

1. Introduction

Happiness is for sure the primary goal of any individual, no matter if we refer to ordinary happiness (a brief state of mind where the individual feels that all the important goals have been reached and the essential needs fulfilled) or to genuine happiness (a durable state of mind during which the individual manages to achieve a balance between goals and needs on the one side and surrounding on the other) defined by Jacobsen (2007). Despite the fast technological evolution, the human brain and the drivers of individual happiness have not changed. We still need to be healthy, connected with our beloved, have spare time to enjoy life and have a meaningful existence aside from the virtual space.

Digitalisation has many advantages in creating new business opportunities, encouraging innovation, and providing new instruments and tools for different sciences, including medical, engineering and social sciences. In the European Commission's priority agenda for 2019-2024, entitled "A Europe fit for the digital age", digitalisation is also seen as a promoter of an open and democratic society that enables a sustainable economy and helps governments and individuals fight climate change.

Governmental and non-governmental organisations have also benefited from digitalisation, primarily through artificial intelligence, big data, the Internet of Things, and digital twins (Andersson and Ivory, 2022; Efthymiou and Sidiropoulos, 2023; Germann and Jasper, 2020). For example, UK Transport for Greater Manchester uses different Microsoft Azure solutions to monitor traffic flow and reduce congestion. In Qatar, the TASMU platform helps the state to manage virtual healthcare consultation and intelligent parking and protect national food security using artificial intelligence, cloud and digital twins. In NGOs, for example, the Association for Social Affairs and Health in Northern Ostrobothnia created the Toimeksi 2.0 project, the aim of which is to create an online service for NGOs and citizens targeted to activate the citizens' participation in society through events, training courses, support group and volunteer work. (Kurtti and Berg, 2018).

On the other side, digitalisation is found to impact negatively on health and personal traits. Sedentarism and obesity were connected with more extended periods spent in front of a screen and reduced physical activities. Also, digitalisation generates significant changes in personal life and work, leading to increased dissatisfaction, higher inequality and a more polarised society (Frey and

Osborne, 2017). Frequent use of social network sites seems to lead to increased stress, harassment and aggressive acts, impairs personality, increases task distraction, reduces positive emotions, and overall reduces quality of life (Baccarella et al., 2018; Moqbel and Kock, 2018; Sands et al., 2020).

This paper aims to see if there is a direct relation between overall digitalisation and its components and happiness in a period characterised by the massive digitalisation enhanced by the COVID-19 pandemic. Even if many papers connect digitalisation with several aspects related to the quality of life, the literature that links digitalisation with aggregated happiness is still extremely scarce. From this point of view, the present paper could be an instrument in governmental policies to shape the digitalisation process to serve the people better. The paper is structured as follows: the second section presents the literature and the research questions, the third section is dedicated to the data and methodology used, the fourth section presents the results, and the last one concludes.

2. Literature review

The literature that asses the direct correlation between digitalisation and aggregated happiness is relatively scarce, especially in empirical studies. Most studies highlight both digitalisation's opportunities and threats to well-being/happiness.

Büchi et al. (2018) analysed whether internet use impacts the five dimensions of social well-being: social integration, contribution, coherence, actualisation and acceptance (in the present paper, happiness and well-being are used in their interchangeable sense, in accordance with Seligman's (2002) view). Based on structural equation modelling, the results point out that how people feel about digital belongingness directly increases social well-being more than the behaviour of digital participation itself. Overall, at the adult population level, digital participation's net effect is negligible.

Torres and Augusto (2020), based on an empirical study conducted in 27 countries in 2016-2018, state that digitalisation may improve national well-being and represent a catalyst if the country has an adequate educational system, a sound governance system, and a philanthropy-oriented financial system. Social entrepreneurship was found indifferent to well-being in countries with high levels of digitalisation coupled with a good education system, stable governance and philanthropic financial systems, such as Finland, Austria and Netherlands. However, in countries such as Thailand, Indonesia and Morocco, the absence of social entrepreneurship, associated with low levels of digitalisation, inadequate governance and an educational system, seems to lead to low levels of well-being.

Using the components of the Digital Economy and Society Index (DESI) on a period from 2014 to 2019, Elmasssah and Hassanein (2022) found that, for EU countries, internet connectivity, the use of the internet and integrated digital technology are related positively to life satisfaction while human capital and digital public services seem to be negatively correlated.

Kiviaho and Einolander (2023) analysed the impact of digitalisation in rural areas and shrinking communities (eight shrinking municipalities in Finland). They found that digital transformation impacts well-being mainly positively in their case. Digitalisation enables small communities to use public services priorly out of reach and opens new opportunities. In this way, due to the help of technology, secluded, isolated communities benefit from remote working, distance learning, remote services and e-commerce, all important considering the citizen's well-being.

Overall, the relationship between digitalisation and happiness is still under debate, with a clear need for more empirical studies to address digital transformations' impact on aggregated happiness and how governments may shape this process to increase the benefits and limit its downsides.

Due to the COVID crisis, the last period may be considered the largest experiment of forced digitalisation humanity has known. That offers us the data to reexamine digitalisation's impact on happiness, considering the scarcity of the previous studies and the contradictory results found in the literature.

Consequently, the present study proposes the following research questions:

RQ 1: Is there any correlation or causality between the increase in overall digitalisation and aggregated happiness?

RQ 2: What components of digitalisation are more prone to influence happiness?

3. Research methodology

To answer the *first research question* and capture the digitalisation effect on aggregated national happiness, the study uses yearly data (2017-2022) of the Digital Economy and Society Index (DESI) in overall values and its sub-dimensions and Happiness Index for the EU countries. Additionally, the study uses population density as a control variable since the previous literature states a negative correlation between urban agglomeration and happiness due to the associated undesirable outcomes as pollution, crimes, and diseases increase (Okulicz and Mazelis, 2018). All the used variables, their acronyms used in the econometric study, and the source of data are included in the following table:

Table no. 1. Variables description

Variable acronym	Description		Source
HI	Happiness Index - includes an aggregated self-assessment of life evaluation provided by the Gallup World Poll.		World Happiness Report available at:https://worldhappiness.report/
DESIO	DESI overall index - computed as a weighted average of the four dimensions: human capital, connectivity, integration of digital technology and digital public service		European Commission, available at: https://digital-agenda-data.eu/charts
IUS	DESI sub-dimensions	Internet User Skills	
ASD		Advanced Skills and Development	
FBTU		Fixed broadband take-up	
FBC		Fixed broadband coverage	
MB		Mobile broadband	
BPI		Broadband price index	
DI		Digital intensity	
DTB		Digital technologies for businesses	
ECOM		e-commerce	
EGOV		e-governance	
PD	Population density		European Union, available at: https://ec.europa.eu/eurostat

Source: author's compilation

Raw data were logarithmised in the case of population density, where the historical values exceeded 100 to reduce the amplitude and ensure better results. All variables were tested for stationarity to avoid spurious regressions with Fisher-PP and Hadri tests, with constant only (because the series has only six years, we assume the trend inconsistency). Except for lnPD, all variables were found to be non-stationary in value but stationary in first differences. As a result, all the presented models in this study use the main variables in the first difference, denoted with D (i.e. DHI, DDESIO, DIUS, etc.).

A naive OLS panel model below is proposed first to test the correlation between the overall digitalisation. In the equation, c is the intercept, y stands for happiness (D(HI)), x denotes the overall digitalisation (expressed by the variable D(DESIO)), μ is the population density (D(PD)), α, β, δ are the slopes of the independent variables, ε is the standard error, i represent the country while t stands for time. National happiness is a persistent variable. Even if, at the individual level, happiness can have quite a high volatility, the aggregated happiness is a pretty stable variable, dependent on its previous year's values. As a result, an auto-regressive effect was included in the equation.

$$y_{it} = c + \alpha y_{i(t-1)} + \beta x_{it} + \delta \mu_{it} + \varepsilon_{it} \quad (1)$$

The panel may present homogeneity issues since each country may exhibit some specificities that may influence the variables included in the regression. Fixed-effects panel models may represent an excellent solution to mitigate this problem. The model, in this case, looks as follows:

$$y_{it} = c_i + \alpha y_{i(t-1)} + \beta x_{it} + \delta \mu_{it} + \varepsilon_{it} \quad (2)$$

In some cases, fixed-effect panel models do not control for all covariates, so that a random-effects panel may be helpful. Even if the number of cross-sections in our case is larger than the number of periods, a random-effect panel is also created and tested.

$$y_{it} = c_i + \alpha y_{i(t-1)} + \beta x_{it} + \delta \mu_{it} + (v_i + \varepsilon_{it}) \quad (3)$$

where v_i stands for a standard random variable with zero mean.

The F-test and Hausman tests were performed to discriminate between the three models, OLS, fixed-effects models and random-effects models. The Granger causality test was employed to check for causality between the variables.

To answer the *second research question* related to the impact of digitalisation sub-dimensions on happiness, the first step was to create the correlation matrix since we expect some correlation between different sub-dimensions. The correlogram results are presented in the table below.

Table no. 2. Correlation matrix for digitalisation sub-dimensions

Correlations	IUS	ASD	FBTU	FBC	MB	BPI	DI	DTB	ECOM	EGOV
IUS	1.0000									
ASD	0.6235	1.0000								
FBTU	0.3425	0.3062	1.0000							
FBC	0.1143	0.3325	0.5535	1.0000						
MB	0.3654	0.3560	0.4200	0.3445	1.0000					
BPI	-0.3056	0.0090	-0.1060	0.2749	0.1483	1.0000				
DI	0.7251	0.6671	0.4731	0.2710	0.5967	-0.1952	1.0000			
DTB	0.7107	0.6746	0.4714	0.3839	0.6039	-0.1558	**0.9223**	1.0000		
ECOM	0.5572	0.4854	0.3143	0.0841	0.2981	-0.3232	0.6321	0.5618	1.0000	
EGOV	0.6917	0.6798	0.4604	0.5397	0.4568	-0.0274	0.7572	0.7264	0.4975	1.0000

Source: author's computation

As one may see, the only two variables that have high correlation coefficients (higher than 0.8) are digital intensity (DI) and Digital technology for business (DTB), so we decided to exclude one of them from our list of independent variables, and the initial OLS panel model is as follows:

$$y_{it} = c + \alpha y_{i(t-1)} + \sum_{k=1}^{n} \beta_k \, x'_{it} + \delta \mu_{it} + \varepsilon_{it} \quad (4)$$

where x' is digitalisation sub-dimensions k by n type (first-order differences of IUS, ASD, FBTU, FBC, MB, BPI, DTB, ECOM, EGOV).

Similarly to overall digitalisation, fixed-effects and random-effects panels were created and tested with F-test and Hausmann tests. The equations for the fixed and random-effects panels may be written as follows:

for fixed effects panel: $y_{it} = c_i + \alpha y_{i(t-1)} + \sum_{k=1}^{n} \beta_k \, x'_{it} + \delta \mu_{it} + \varepsilon_{it}$ (5)

for random effects panel: $y_{it} = c_i + \alpha y_{i(t-1)} + \sum_{k=1}^{n} \beta_k \, x'_{it} + \delta \mu_{it} + (v_i + \varepsilon_{it})$ (6)

4. Findings

The empirical results for the first set of equations show that the OLS naive model (model 1) is a better representation than the fixed-effects (model 2) and random-effects models (model 3). As one may see in Table 3 below, the F-test shows that there is an 18% probability that the fixed effect model will generate better outcomes than the naive OLS, and the Hausman test shows that there is a 0% probability that the random effects model to generate better results compared with the fixed effect one.

The overall DESI is negatively correlated with happiness, significant at 1% (Table no. 3). As expected, the control variable, population density, negatively correlates with happiness since it is usually associated with higher pollution, crime, and disease (at a significance level of 5%).

Table no. 3. Empirical results for overall digitalisation -happiness correlation

Dependent variable	**D(HI)**		
Independent variables	**OLS**	**FE**	**RE**
	(1)	**(2)**	**(3)**
Intercept	0.308*** (0.063)	13.428** (4.996)	0.308*** (0.061)
D(HI(-1))	0.208** (0.095)	-0.213* (0.122)	0.208** (0.091)
D(DESIO)	-0.032*** (0.007)	-0.030** (0.007)	-0.031*** (0.006)
LNPD	-0.030** (0.011)	-2.846** (1.074)	-0.029** (0.011)
R squared	0.279	0.498	0.279
F-test		1.306	
[p-value]		[0.183]	
Hausman test			28.12
[p-value]			[0.000]
No. Of Observations	108	108	108
(a) (…) denotes the standard error, while […] is the p-values; (b) ***, **, and * show significance at 1, 5 and 10 % level of significance, respectively			

Source: author's computation

The reverse causality hypothesis was tested in the second step by employing a Granger causality. The results presented in Table no. 4 allow us to reject the null hypothesis (DDESIO does not Granger Cause DHI) and conclude that increased digitalisation leads to reduced happiness.

Table no. 4. Results of the Granger causality test

Null Hypothesis:	**Prob.**
DDESIA does not Granger Cause DHI	0.0001
DHI does not Granger Cause DDESIA	0.8999

Source*: author's computation*

At the sub-dimension level, after testing the OLS naive model specification, statistically significant correlations were found only in the case of internet users' skills, fixed broadband coverage, mobile broadband and e-governance, all of them negatively correlated with happiness (see model 1 results in Table no.5 below). To improve the model's efficiency in the next step, the variables that do not correlate significantly with happiness were excluded from the model and population density, as a control variable, was added to see if the coefficients of the significant independent variables maintained their significance (see model 2 results). As one may notice, the R-squared values are improved in the second model, and the independent variable coefficients maintain their signs.

Table no.5. Empirical results for the relation digitalisation sub-dimension and happiness

Dependent variable	**D(HI)**			
Independent variables	**OLS**	**OLS**	**FE**	**RE**
	(1)	**(2)**	**(2)**	**(3)**
Intercept	0.333*** (0.059)	0.490*** (0.079)	9.396** (5.194)	0.490*** (0.080)
D(HI(-1))	0.195** (0.099)	0.140* (0.096)	-0.197 (0.124)	0.140 (0.096)
D(IUS)	-0.118** (0.058)	-0.140** (0.054)	-0.187*** (0.070)	-0.140** (0.054)
D(ASD)	0.009 (0.010)			
D(FBTU)	-0.015 (0.014)			
D(FBC)	-0.012*	-0.012*	-0.014**	-0.012*

	(0.007)	(0.007)	(0.007)	(0.007)
D(MB)	-0.004* (0.003)	-0.005* (0.002)	-0.006** (0.002)	-0.005** (0.002)
D(BPI)	-0.003 (0.018)			
D(ECOM)	0.006 (0.019)			
D(EGOV)	-0.036** (0.011)	-0.041*** (0.010)	-0.041*** (0.014)	-0.041*** (0.010)
D(DTB)	-0.016 (0.009)			
LNPD		-0.033*** (0.011)	-1.937* (1.122)	-0.033*** (0.011)
R squared	0.338	0.362	0.553	
F-test			1.236	
[p-value]			[0.237]	
Hausman test				26.03
[p-value]				[0.000]
No. Of Observations	108	108	108	
(a) (…) denotes the standard error, while […] is the p-values; (b) ***, **, and * show significance at 1, 5 and 10 % level of significance, respectively				

Source: author's computation

Similar to the analysis conducted for overall digitalisation, in this case, the OLS naive model is superior to the fixed effect model (model 3) and the random effects model (model 4). There is a 23.7% probability that the fixed effect model will generate better results than the naive OLS, so we would choose naive OLS against the fixed effect model and a 0.00% probability that the random effect model will perform better than the fixed effect model. Hence, the OLS is our best choice.

Unsurprisingly, all the significant sub-dimensions correlate negatively with happiness at different levels of significance (e-governance at 1%, internet user's skills at 5%, fixed broadband coverage and mobile broadband at 10%).

Even if the highest coefficient appears to be the one for internet users' skills in this case, the causality seems to be reversed, meaning that a happiness-positive shift determines an unfavourable evolution of internet users' skills (see Table no.6 below). This may be explained if we consider the fact that usually happy people are the ones who live a meaningful life, are surrounded by friends and family and depend less on the virtual environment to attain pleasure and a good mood.

Table no. 6. Granger causality test results

Tested causality	Null Hypothesis	Probability
Internet user's skills and happiness	DIUS does not Granger Cause DHI	0.125
	DHI does not Granger Cause DIUS	**0.005**
E-governance and happiness	DEGOV does not Granger Cause DHI	**0.008**
	DHI does not Granger Cause DEGOV	0.387
Fixed broadband coverage and happiness	DFBC does not Granger Cause DHI	0.157
	DHI does not Granger Cause DFBC	0.546
Mobile broadband and happiness	DMB does not Granger Cause DHI	**0.001**
	DHI does not Granger Cause DMB	0.532

Source: author's computation

Null Hypotheses „ DEGOV does not Granger Cause DHI" and „DMB does not Granger Cause DHI" may be rejected due to their probability values. Hence, the two sub-dimensions that negatively impact happiness are e-governance and mobile broadband.

5. Conclusions

In the last decades, digitalisation has often been seen as a way to increase economic growth and innovation, reduce inequalities, improve public services and public health, promote democracy and fight climate change. Various governments, including the EU countries, included digitalisation among their priorities, considering that this approach better serves their citizens.

In recent years, several researchers (Gluckman and Allen, 2018; Behne and Teuteberg, 2020; Turel et al., 2021; Rohwer et al, 2022; Olçum and Gülova, 2023) pointed out that digitalisation also has a dark face and that it has to be made with caution to exploit only its advantages without damaging public health, social relationships and, in the end, the individual's quality of life.

The results of this empirical study support this last idea. Despite the positive effects digitalisation may induce, its overall effect on such a complicated construct as happiness is negative. Individuals still need friends and family, free quality time, physical health and mindfulness to be happy; no computer or virtual interaction can replace that.

The results in the digitalisation sub-dimension reinforce the overall digitalisation impact on happiness.

Even if it is strange at first glance, since e-government is often considered a way to improve citizens' quality of life, the results may be explained easier if we rely on psychology. Individuals suffer very often from status-quo bias and are reluctant to change. Digitalisation may create stress, especially in older adults' cases when they must learn about new technologies and digitalise their interaction with public entities. Plus, digitalisation limits the direct social interactions needed to live a fulfilled life. For some individuals who work remotely or in solitude and have no family, or for elderly individuals, the e-government may cause an even lower level of direct social interaction and a decreased quality of life.

Referring to the mobile broadband connection with happiness, the obtained causality may be easily explained. High-speed internet access via mobile networks has made our lives easier in various ways, but, at the same time, one cannot neglect the adverse effects. Individuals spend much more time in solitude or the virtual world, and kids and young adults are often trapped by their phones, tablets or computers, losing the connection with the real world; minute after minute, we change the way we see life, social interaction, work environment, friendship, even love. Life seems to be easier but is not happier.

These conclusions and previous research highlight the need for a policy twist from „unlimited digitalisation" to „shaped digitalisation to serve the people better", considering both digitalisation's advantages and disadvantages and setting clear lines and limits. Humanity cannot return to the pre-digital era but may design digitalisation public policies to serve its supreme goal: happiness.

6. References

- Andersson, C., Hallin, A. and Ivory, C., 2022. Unpacking the digitalisation of public services: Configuring work during automation in local government. *Government Information Quarterly*, *39*(1), pp.101662. https://doi.org/10.1016/j.giq.2021.101662
- Baccarella, C. V., Wagner, T. F., Kietzmann, J. H. and McCarthy, I. P., 2018. Social media? It's serious! Understanding the dark side of social media. *European Management Journal*, *36*(4), pp.431-438. https://doi.org/10.1016/j.emj.2018.07.002
- Behne, A. and Teuteberg, F., 2020. A Healthy Lifestyle and the Adverse Impact of its Digitalization: The Dark Side of Using eHealth Technologies. *Wirtschaftsinformatik (Zentrale Tracks)* , March Issue, pp. 584-599. https://doi.org/10.30844/wi_2020_f2-behne
- Büchi, M., Festic, N., and Latzer, M., 2018. How social well-being is affected by digital inequalities. *International Journal of Communication*, *12*, pp.3686-3706.
- Efthymiou, I. P., Alevizos, A. and Sidiropoulos, S., 2023. The Role of Artificial Intelligence in Revolutionizing NGOs' Work. *Journal of Politics and Ethics in New Technologies and AI*, *2*(1), pp.e35137-e35137. https://doi.org/10.12681/jpentai.35137
- Elmassah, S. and Hassanein, E.A. , 2022. Digitalisation and subjective wellbeing in Europe. *Digital Policy, Regulation and Governance*, 24(1), pp. 52-73. https://doi.org/10.1108/DPRG-05-2021-0060

- Frey, C. B. and Osborne, M. A., 2017. The future of employment: How susceptible are jobs to computerisation? *Technological forecasting and social change*, *114*, pp.254-280. https://doi.org/10.1016/j.techfore.2016.08.019
- Germann, S. and Jasper, U., 2020. Realising the benefits of data driven digitalisation without ignoring the risks: health data governance for health and human rights. *Mhealth*, *6*. https://doi.org/10.21037/mhealth-2019-di-11
- Gluckman, P. and Allen, K., 2018. Understanding well-being in the context of rapid digital and associated transformations Implications for research, policy and measurement. *The International Network for Government Science Advice*
- Jacobsen, B., 2007. What is happiness? *Existential Analysis: Journal of the Society for Existential Analysis*, *18*(1), pp.39-50.
- Kiviaho, A. and Einolander, J., 2023. Digital transformation, well-being and shrinking communities: Narrowing the divides between urban and rural. *Heliyon*, *9*(8), e18801. https://doi.org/10.1016/j.heliyon.2023.e18801
- Moqbel, M. and Kock, N., 2018. Unveiling the dark side of social networking sites: Personal and work-related consequences of social networking site addiction. *Information & Management*, *55*(1), pp.109-119. https://doi.org/10.1016/j.im.2017.05.001
- Olçum, G., and Gülova, A. A., 2023. Digitalisation and Generation Z: Advantages and Disadvantages of Digitalization. In *Two Faces of Digital Transformation: Technological Opportunities versus Social Threats* Emerald Publishing Limited, pp. 31-46.
- Rohwer, E., Flöther, J. C., Harth, V.and Mache, S., 2022. Overcoming the “Dark Side” of Technology—A scoping review on preventing and coping with work-related technostress. *International journal of environmental research and public health*, *19*(6), pp.3625. https://doi.org/10.3390/ijerph19063625
- Sands, S., Campbell, C., Ferraro, C. and Mavrommatis, A., 2020. Seeing light in the dark: Investigating the dark side of social media and user response strategies. *European Management Journal*, *38*(1), pp.45-53. https://doi.org/10.1016/j.emj.2019.10.001
- Seligman, M. E., 2002. *Authentic happiness: Using the new positive psychology to realise your potential for lasting fulfilment*. New Yourk: Simon and Schuster.
- Turel, O., Qahri-Saremi, H., and Vaghefi, I., 2021. Dark sides of digitalisation. *International Journal of Electronic Commerce*, *25*(2), pp.127-135. https://doi.org/10.1080/10864415.2021.1887694
- Torres, P. and Augusto, M., 2020. Digitalisation, social entrepreneurship and national well-being. *Technological Forecasting and Social Change*, *161*, pp.120279. https://doi.org/10.1016/j.techfore.2020.120279