Understanding country performance in Digital indexes

There has been growth in the number of international indexes benchmarking country performance

Innovative analysis using over 100 indicators explains differences in performance between EU Member States

15 Member States are performing above expectations relative to their national conditions

There has been growth in recent years in the number of international indexes that benchmark performance between different countries. Several indexes investigate how well countries integrate digital technologies into society, everyday life and economies. Most indexes simply present a score and rank for countries, without considering the natural endowments and conditions that are known to affect performance. This paper describes innovative pilot research examining the conditions that explain variance in digital connectivity between EU28 Member States. The methodology will be developed further and used to investigate other international indexes. If you have ideas about explanatory variables that should be included in future research please contact us.

Introduction

Economists claim that national economic performance is based on natural endowments, labour resources, skills, interest rates, currency value and other factors including cultural outlook[1]. Countries have conditions that are advantageous for some activities and not for others[2]. Natural endowments and/or conditions also determine how well countries integrate digital technologies into society, everyday life and economies – this is usually described as digitalisation[3].

This paper describes innovative pilot research which highlights the need to reconsider digitalisation indexes and benchmarking studies and undertake research to better understand the natural endowments and conditions that enable countries to perform well.

Research examines the conditions that support digital connectivity, as measured by eleven DESI variables for fixed and mobile broadband coverage, subscriptions and cost. After identifying these conditions it is possible to see how well each country performs relative to their local natural endowments and conditions. This reveals differences with the DESI connectivity performance ranking. 15 EU28 Member States are performing above the level that would be expected after taking into account local conditions.

The methodology will be developed further and used to investigate other international indexes and benchmarks.

The conclusion requests ideas from readers about additional explanatory variables that might be included in future research to better understand differences between countries in their digital performance.

Digital Indexes and benchmarks

In the last 20 years there has been growth in the use of benchmarking[4]. Benchmarking has become an important tool for domestic regulation. International organisations (governments, universities, research organisations and private companies) are producing a growing number of indexes to assess relative national performance.

[1] Porter M. 1990. The Competitive advantage of nations. Harvard Business Review. https://hbr.org/1990/03/the-competitive-advantage-of-nations

[2] Hall M. 2018. Is comparative advantage in everything possible for a company. Investopedia. https://www.investopedia.com/ask/ answers/033015/it-possible-country-have-comparative-advantage-everything.asp

[3] Bloomberg J. 2018. Digitization, digitalization, and digital transformation: Confuse them at your peril. Forbes. https://www.forbes.com /sites/ jasonbloomberg /2018/04/29/digitization-digitalization-and-digital-transformation-confuse-them-at-your-peril/#62f3c9682f2c.

[4] Broome A, Homolar A and Kranke M. 2018. Bad science: International organizations and the indirect power of global benchmarking. European Journal of International Relations. 24, 3. p514 – 539. https://journals.sagepub.com/doi/full/10.1177/1354066117719320

Benchmarks are increasing in importance as tools for the comparative evaluation of countries' institutional design, policy agendas, regulations and impacts across different areas including climate change action, corruption[5] and poverty reduction[6]. The European Union has more than 15 different Member State Indexes.

Digitalisation Indexes include:-

The ***World Economic Forum Networked Readiness Index*** measures the propensity for countries to exploit the opportunities offered by information and communications technology in 139 countries;

The ***United Nations eGovernment Survey:*** Since 2003 this index has measured the development of telecommunication infrastructure, human capacity and eGovernment online services;

The ***OECD*** produces digital economy reports based on OECD data for their 34 member countries;

The ***Global Open Data Index*** is the Open Knowledge Network global benchmark for open government data.

It can be argued that digitalisation benchmarking is one of the oldest areas for international benchmarking. The International Telecommunication Union (ITU) became a specialised agency of the United Nations in 1947[7]. The ITU is active in areas including broadband Internet, wireless technologies, satellite communications, Internet access, data, voice, and next-generation networks[8].

Developing an index: DESI

Over the last 50 years researchers developing indexes have identified a number of challenging conceptual, methodological, practical and political problems. The Digital Economy and Society Index (DESI[9]) and International DESI[10] provide robust examples of a seven stage methodology to create an Index, see the adjacent figure.

Any index has to be 'fit for purpose' and meet the needs of the organisations and policymakers for whom it is being developed. This gives rise to a conundrum. On the one hand to enable robust international comparisons countries need to agree to collect exactly the same information. On the other hand the more countries that are involved in information collection and analysis the greater will be the compromises about the precise data

1. Clarifying purpose and goals
Ensuring fitness for purpose for all partners

2. Data collection, selection and validation
Matching data requirements to goals and ensuring quality

3. Normalisation
Adjusting data with different scales to a common scale

4. Estimation of missing values
Searching for other sources or mathematical estimations

5. Application of weights
Weights to reflect the relevance of different dimensions

6. Correlation analysis
Analysis to minimize covariance between indicators

7. Calculating the final index
Analysis to determine the index and trends

collected and this could ultimately mean Indexes are less suitable for the purpose of each contributor. A large number of countries, or countries from diverse socio-economic circumstances, can lead to a large range of results when comparing country performances. As noted earlier it is commonly recognised that natural endowments and conditions cause countries to perform differently. These underlying factors and natural endowments are not usually investigated or considered when index results are presented.

Benchmarking: Benefits and difficulties

There are considerable benefits for policymakers in knowing how their approach compares with other countries.

Benefits: Results from benchmarking can act as a catalyst to improving strategic digital policy development. Coherence and better co-ordination can be developed to address weaknesses identified by benchmarking[11]. Benchmarking results enable policymakers to learn from others and consider if there is potential for doing things differently in future. Finally, benchmarking provides transparency in assessing performance, it can reveal countries that are not performing as well as previously thought[12].

[5] Baumann H. 2017. A failure of governmentality: Why Transparency International underestimated corruption in Ben Ali's Tunisia. Third World Quarterly. 38,2. p467 – 482. https://core.ac.uk/download/pdf/82984944.pdf

[6] Freistein K. 2016. Effects of indicator use: A comparison of poverty measuring instruments at the World Bank. Journal of Comparative Policy Analysis: Research and Practice. 18, 4. p366–381. https://www.tandfonline.com/doi/abs/10.1080/13876988.2015.1023053

[7] Graham N. and Jordan R. 2013. The International Civil Service: Changing role and concepts. Pergamon, New York.

[8] ITU. 2018. https://www.itu.int/en/about/Pages/default.aspx

[9] https://publications.europa.eu/en/publication-detail/-/publication/8362d114-db2e-11e8-afb3-01aa75ed71a1

[10] Produced by Tech4i2 https://ec.europa.eu/digital-single-market/en/news/international-digital-economy-and-society-index-2018

[11] Zeitlin J. (2007) A Decade of Innovation in EU Governance: The European Employment Strategy, the Open Method of Coordination and the Lisbon Strategy. La Follette School Working Paper Series No 2007-031, http://www. lafollette.wisc.edu/publications/workingpapers

[12] World Bank (2014) Good practice paper on benchmarking, monitoring and evaluation.

Difficulties: Global benchmarks based on country rankings are deceptively easy to communicate and consume. However, commentators highlight political and practical impacts of benchmarking that are not always beneficial.

Some assert that international benchmarking represents a new and distinctive application of authority in world politics[13] that promulgates 'best practice' policy norms based on Western values[14]. Judgement is typically expressed through the language of numbers that are more difficult for stakeholders and practitioners to ignore. They assert that it is difficult to argue with a simple numerical ranking, especially when this serves as a reference point for political debates about a given issue. Unintended consequences[15] can also arise. These include gaming; whereby nations pursue improved performance in specific indicators included in an Index to ensure their position rises in later years[16].

Benchmarking can be problematical, particularly in the relationship between two of the key groups that pay greatest attention to benchmarking indexes – policymakers and politicians. Comparative benchmarking usually only has 'winner' and many losers. Many policymakers are ambivalent about the comparative elements of benchmarking. They realise the normative views being promulgated and usually better understand the local social, cultural and economic circumstances that explain comparative performance between countries. Politicians often have greater, and sometimes less informed, concerns about their country's performance. Sometimes this results in a positive impact with more support and/or resources for policymakers so that performance might be improved in the future. At the other extreme policymakers can demand the pursuit of improvements in a country's performance for indicators that do not align with strategic goals or are entirely inappropriate for a country.

What factors affect digitalisation performance?

Very little research appears to have been undertaken to find the key factors that explain differential performance between countries. Understanding of these key factors would enable national policymakers to improve understanding of differential national performance and to better influence the factors having the greatest impact on particular indicators. Analysis also enables countries to understand how they are performing relative to local natural endowments and conditions.

Methodology

Tech4i2 and Leicester University are undertaking experimental analysis to investigate the factors that explain performance differences between countries. Our team identified more than 100 variables and statistics that might explain variations (mathematicians call this variance) in the Digital Economy and Society Index and the International DESI. Key categories for these explanatory variables included:-

Central government assets/debt	Labour force (equality, status, productivity)
Climate (temp, sunshine rain)	Land use (urban, agriculture, forest, highland)
Education (all levels, gender and age ranges)	Military expenditure
Emissions and recycling	Population (density, gender and age ranges)
Employment market (growth, full/part time, earnings)	Product and services markets
Financial market (banking, borrowing, debt)	Public support/social inclusion (poverty, childcare)
GDP and international trade	Research and innovation
Goods and services exports	Tourism (arrivals, departures, establishments)
Green growth (energy balance, waste)	Transport (automotive, train, air)
Housing (households, density, deprivation)	Urbanity/rurality

A small number of variables (four or five) were selected for each category for the pilot analysis. In most categories many more explanatory variables could have been selected. Your input in suggesting areas that should be examined more closely or in suggesting other categories is requested at the end of this paper.

After collection of explanatory variables mathematical methods, including cluster analysis and correlation analysis, were undertaken to avoid multicollinearity[17]. When a suitable list of explanatory variables had been

[13] Broome A and Quirk J. 2015. The politics of numbers: the normative agendas of global benchmarking. Review of International Studies. 41. p813–818.

[14] Suzuki S. 2009. Civilization and Empire: China and Japan's Encounter with European International Society. Abingdon: Routledge.

[15] Muller J. 2018. The Tyranny of metrics. Princeton University Press.

[16] Hood C. 2006. Gaming in targetworld: The targets approach to managing British public services. Public Administration Review. 66,4. p515–521. https://onlinelibrary.wiley.com/doi/abs/ 10.1111/j.1540-6210.2006.00612.x

[17] This avoids the use of many variables that measure roughly the same thing or are closely related, this would lead to spurious results.

found multiple linear regression analysis methods were undertaken to identify the variables that explained differences between countries. Residual analysis techniques were then used to provide insights to how countries were performing relative to local natural endowments and conditions.

Explanatory variables (14)	Variance explained
Average temperature	21.00%
Persons employed	17.40%
Emissions	12.58%
Population density	11.09%
At risk of poverty rate	10.79%
Mobile subscriptions	9.08%
Youth population	4.46%
Recycling rate	3.46%
Government military expenditure	1.87%
Research and development expenditure	1.03%
Rainfall	0.41%
International trade	0.29%
Alcohol consumption	0.04%
Healthy life years	0.01%
Total	**93.5 per cent**

Analysis was undertaken for all the DESI and the International DESI dimensions and indicators. The adjacent table lists the 14 variables that explain 93.5 per cent of variation in country performance for the DESI digital connectivity dimension (eleven variables for fixed and mobile broadband coverage, subscriptions and cost).

The table shows the leading variable explaining variance in the connectivity dimension is average temperature – countries with higher temperatures had lower levels of connectivity. This may seem obscure but six years ago Tech4i2 research found a similar strong relationship between fixed connectivity and sunshine hours. One logical explanation could be that when it is warm people prefer to be outside and when it is cold people go inside and use the Internet.

However, the explanation may also be economic. More than 100 years ago Huntington[18] noted a relationship between heat and poverty.

Colacito et al[19] found that on average, each 1˚ Fahrenheit increase in the mean summer temperature reduced annual gross state product growth in the US by 0.15 percentage points. Work on this topic is increasing as researchers attempt to forecast the impact of climate change[20]. However, it must be emphasised that this type of mathematical analysis can only identify correlation not causality. It is possible explanations for temperature as a key explanatory variable are related to other economic factors. One area for further research in our work is the inclusion of more public and private sector economic and financial explanatory variables, particularly for connectivity research which involves large amounts of infrastructure investment.

After identifying significant explanatory variables for the DESI digital connectivity dimension it was possible to see how well each country performed relative to their local natural endowments and conditions. As the adjacent table shows 15 EU28 Member States (shaded in green) were performing above the level that might be expected after taking into account local circumstances. This immediately has the impact of moving attention from a single DESI 'winner' (Denmark) to 15 Member States that are performing above expectations.

It is also notable that Denmark which ranked highest on the DESI connectivity dimension performed at exactly the level that would be expected after taking into account its natural endowments and conditions. This insight suggests that Denmark might not be the best Member State to examine best practices. It is possible that the Member State shaded green, particularly Croatia and Portugal, which are performing above expectations, are those that could offer greatest insights to better practices.

DESI Rank	EU28 Member State	DESI Rank	EU28 Member State	Residual Values	Residual Rank	Ranking Difference
1	Denmark	18	Croatia	0.009	1	+17
2	Sweden	23	Portugal	0.008	2	+21
3	Netherlands	4	Finland	0.006	3	+1
4	Finland	5	Luxembourg	0.005	4	+1
5	Luxembourg	27	Bulgaria	0.005	5	+22
6	UK	2	Sweden	0.005	6	-4
7	Estonia	8	Malta	0.003	7	+1
8	Malta	7	Estonia	0.003	8	-1
9	Germany	20	Slovakia	0.002	9	+11
10	Belgium	12	France	0.002	10	+2
11	Spain	15	Ireland	0.001	11	+4
12	France	11	Spain	0.001	12	-1
13	Austria	25	Italy	0.001	13	+12
14	Lithuania	16	Latvia	0.001	14	+2
15	Ireland	14	Lithuania	0.001	15	-1
16	Latvia	1	Denmark	0.000	16	-15
17	Hungary	17	Hungary	-0.001	17	-
18	Croatia	3	Netherlands	-0.002	18	-15
19	Czech Republic	19	Czech Republic	-0.002	19	-
20	Slovakia	22	Cyprus	-0.002	20	+2
21	Slovenia	26	Greece	-0.003	21	+5
22	Cyprus	13	Austria	-0.003	22	-9
23	Portugal	9	Germany	-0.003	23	-14
24	Poland	6	UK	-0.006	24	-18
25	Italy	10	Belgium	-0.006	25	-15
26	Greece	21	Slovenia	-0.006	26	-5
27	Bulgaria	24	Poland	-0.007	27	-3
28	Romania	28	Romania	-0.011	28	-

Across the five DESI dimensions (connectivity, citizen skills, citizen use, business use and digital public services) the four Member States performing highest above expectations are Croatia, Estonia, Portugal and Sweden.

As noted previously our research is at an early stage of development. If you have ***ideas about explanatory variables that should be included in future research*** please contact us (pdfoley@tech4i2.com).

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[19] Colacito R. Hoffmann B. Phan T. and Sablik T. 2018. The impact of higher temperatures on economic growth. Federal Reserve Bank of Richmond. https://ritholtz.com/2018/08/the-impact-of-higher-temperatures-on-economic-growth/

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