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THE DIGITAL KNOWLEDGE ECONOMY INDEX: MAPPING CONTENT PRODUCTION

Sanna Ojanperä

Mark Graham

Matthew Zook

Oxford Internet Institute, University of Oxford

Fifth IMF Statistical Forum - Measuring the Digital Economy

November 16, 2017

Washington, DC

Age of Knowledge and Information

“In Africa, we have missed both the agricultural and industrial revolutions and in Rwanda we are determined to take full advantage of the digital revolution.

This revolution is summed up by the fact that it no longer is of utmost importance where you are but rather what you can do.”

- Paul Kagame

| Title | Publisher | Date | Countries Covered* | SSA Countries Included* |
|---|--|--|--------------------|-------------------------|
| Frameworks | | | | |
| The Knowledge-Based Economy | OECD | 1996 | 29 | 0 |
| OECD Science, Technology and Industry Scoreboard | OECD | 1999, 2001, 2003, 2005, 2007, 2009, 2011, 2013, 2015 | 35 | 0 |
| Towards Knowledge-Based Economies in APEC | APEC | 2000 | 21 | 0 |
| Knowledge Assessment Methodology | World Bank | 2006 | 146 | 31 |
| Indices | | | | |
| Knowledge Economy Index (KEI) | World Bank | 2010, 2012 | 146 | 31 |
| Knowledge Index (KI) | World Bank | 2010, 2012 | 146 | 31 |
| DESI: Digital Economy and Society Index | European Commission | 2015, 2016 | 28 | 0 |
| State New Economy Index | Information Technology and Innovation Foundation | 2002, 2007, 2008, 2010, 2012, 2014 | 1 | 0 |
| Digital Evolution Index | The Fletcher School Institute for Business in the Global Context | 2008-2013 | 50 | 3 |
| Industry Digitization Index | Strategy& | 2012 | 1 | 0 |
| Mapping the European ICT Poles of Excellence: The Atlas of ICT Activity in Europe | European Commission | 2014 | 28 | 0 |
| Web Index | World Wide Web Foundation | 2013, 2014 | 86 | 21 |

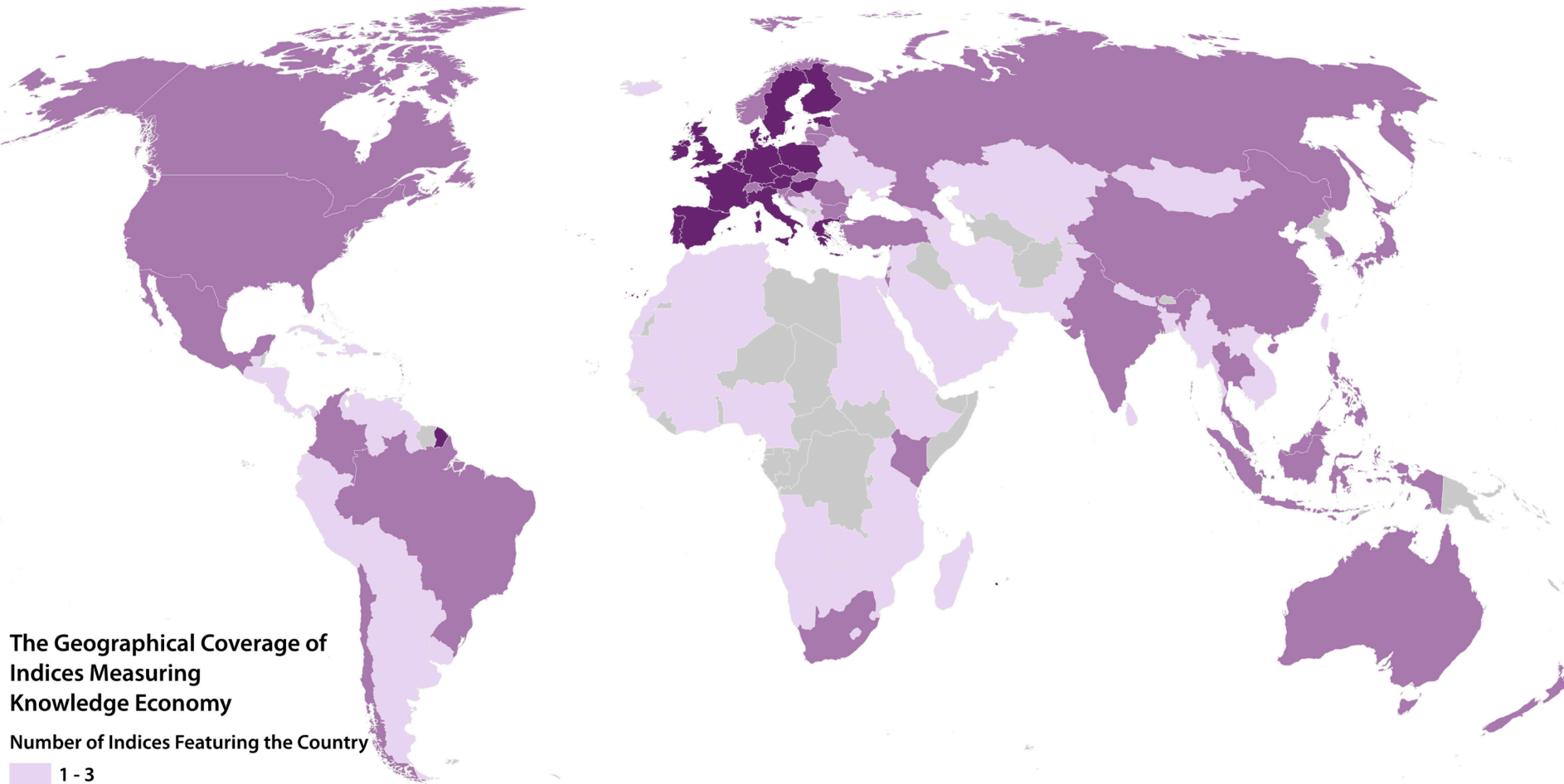


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Geographical Coverage of Knowledge Economy Indices



The Geographical Coverage of Indices Measuring Knowledge Economy

Number of Indices Featuring the Country

- 1 - 3
- 4 - 6
- 7 - 8
- Not Included

The visualization uses data from the indices discussed in the associated paper and from Natural Earth.

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Need for a Reflexive Inquiry

- Indices are often intended to work as easy-to-use interactive tools

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- Indices are often intended to work as easy-to-use interactive tools
- They tend to state general limitations, but often don't encourage deeper reflection about measurement choices
- Index methodology and normalization procedures often presented matter-of-factly

Lacking Measures on Digital Participation

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Lacking Measures on Digital Participation

- Indices focus exclusively on traditional data sources
- Africa's 'statistical tragedy' makes data quality questionable
- Given the centrality of technology and human capital in the knowledge economy, its measurement should feature an estimation of knowledge-rich digital activity

Creating the Digital Knowledge Economy Index (DKEI)

- Inclusion of variables measuring digital participation and knowledge creation
- Emphasis on data selection and measurement choices

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- Inclusion of variables measuring digital participation and knowledge creation
- Emphasis on data selection and measurement choices
- Building on the World Bank Knowledge Economy Index (KEI) data and estimation methodology

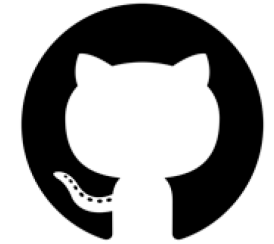
Data on Digital Participation

- Fifth sub-index on digital participation and content creation to consider alongside the existing sub-indices on **education, innovation, economic institutional regime, and ICTs**

Data on Digital Participation

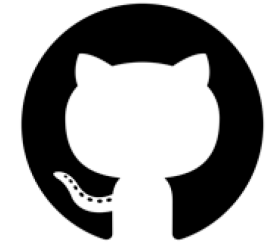
- Fifth sub-index on digital participation and content creation to consider alongside the existing sub-indices on **education, innovation, economic institutional regime, and ICTs**
- Includes variables on:
 - Collaborative coding
 - Wikipedia editing activity
 - Domain registrations

Collaborative Coding



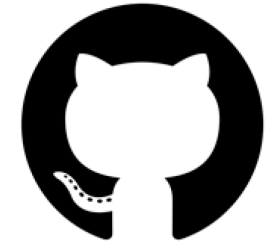
- GitHub code-sharing platform

Collaborative Coding



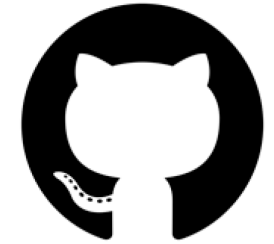
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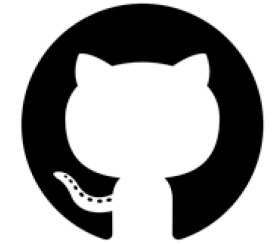
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Collaborative Coding



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 - 25% of users (45% of commits) indicate location
 - Geocoding margin of error

Wikipedia Editing Activity



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- Approximate the capacity to expand and improve knowledge contained in this open resource
- Limitations:
 - False or debatable information or vandalism
 - No metrics on the quality or appropriateness of edits

Domain Registrations



- Top-level domains related to a country

Domain Registrations



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- ccTLDs, gTLDs, and IDNccTLDs

Domain Registrations

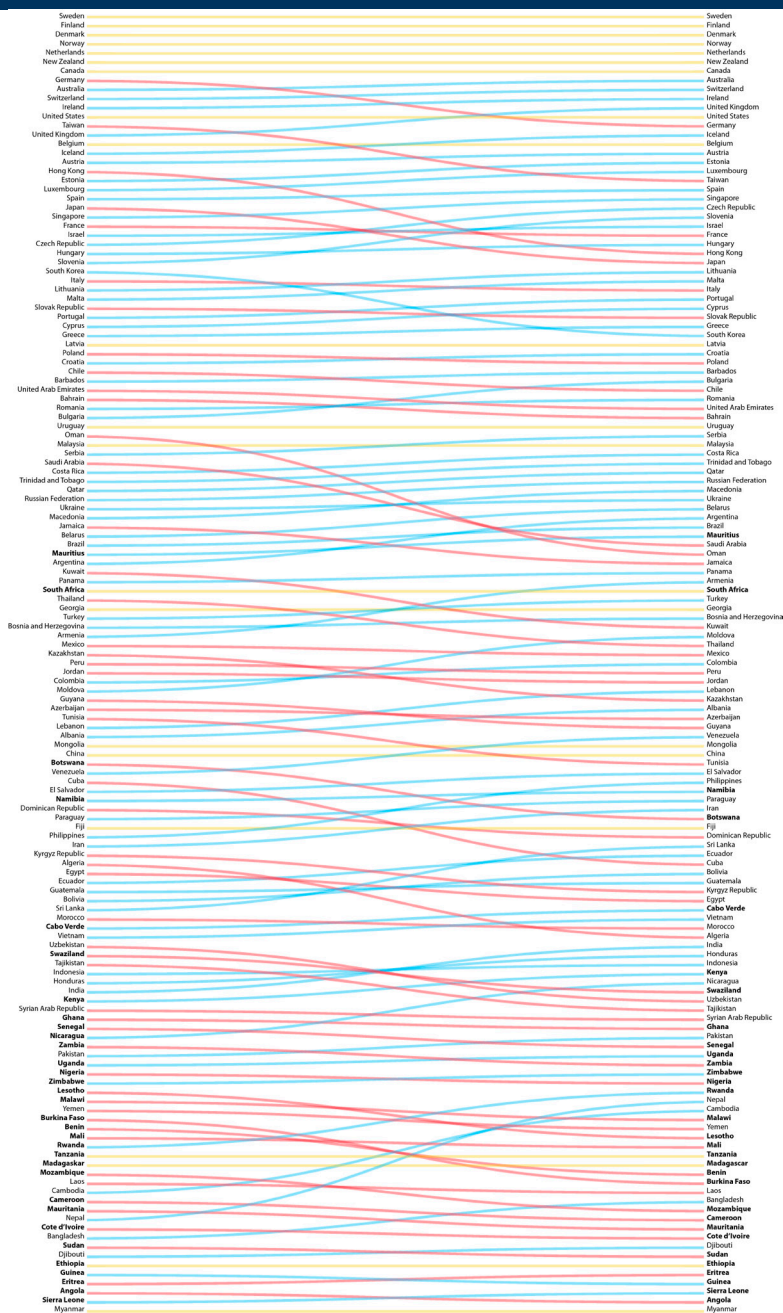


- Top-level domains related to a country
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- Approximate the volume of codified information and knowledge that is accessible online

Domain Registrations



- Top-level domains related to a country
- ccTLDs, gTLDs, and IDNccTLDs
- Approximate the volume of codified information and knowledge that is accessible online
- Limitations:
 - TLD “hacks” eliminated

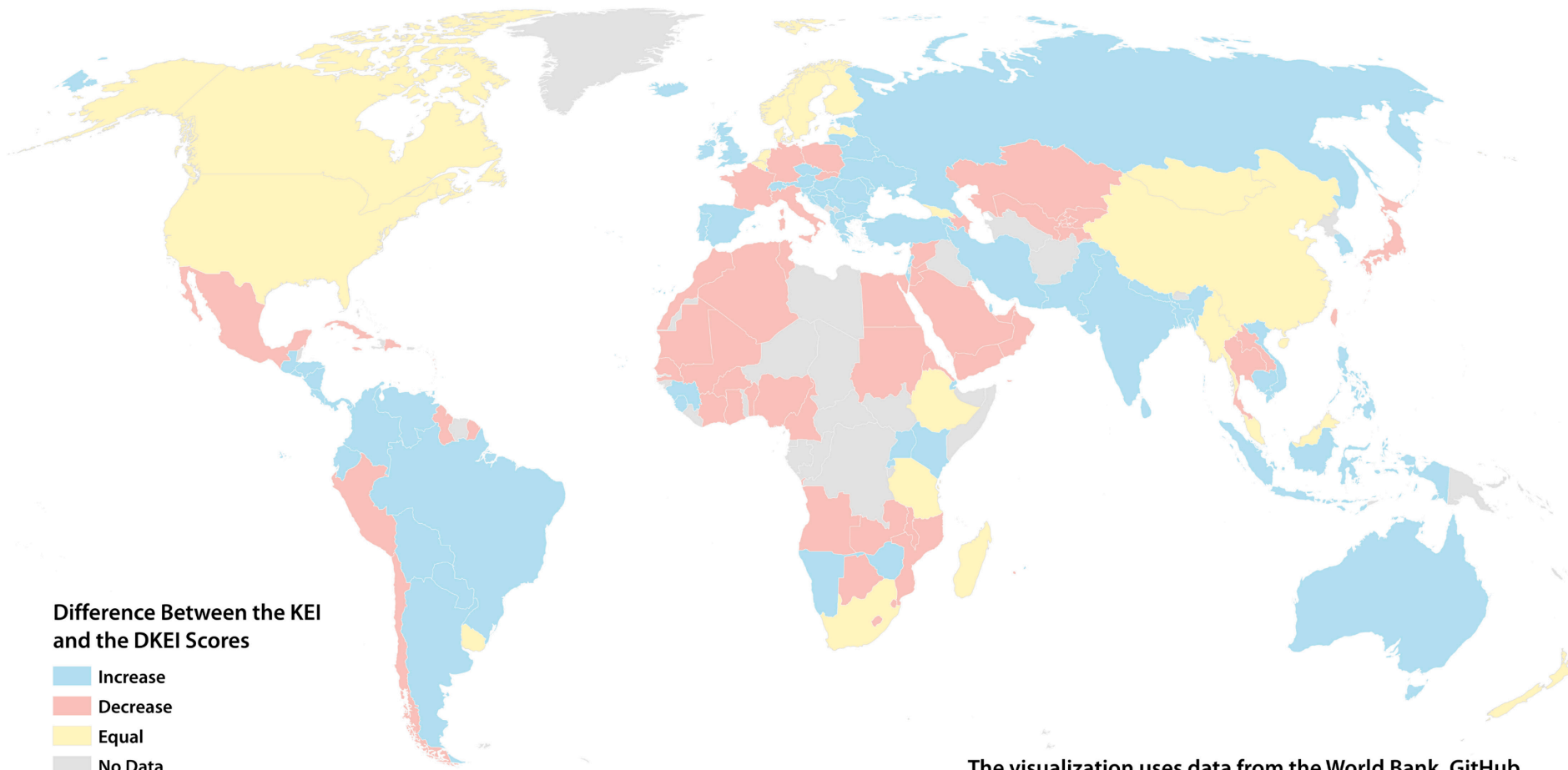


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Shift in the Measurement of the Knowledge Economy



Difference Between the KEI and the DKEI Scores

- Blue Increase
- Red Decrease
- Yellow Equal
- Grey No Data

The visualization uses data from the World Bank, GitHub, Wikipedia, domain registrations and from Natural Earth.

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Conclusions

INTERNET
INTERNET

XEROX

INTERNA

COLOR & B

Including digital participation in the estimation of knowledge economy seems to indicate challenges rather than prospects in Sub-Saharan Africa.

Conclusions

INTERNET
INTERNET

XEROX

Computer printout
SCANNING
FAX
LAMINATION

INTERNA

COLOR & B

PRINTOUT

LAMINATION
SPIRAL B

Heuristic devices such as indices should be accompanied with more reflection about measurement choices.

Conclusions

INTERNET
INTERNET

XEROX

INTERNA

COLOR & B

PRINTOUT

LAMINON

SPIRAL B

Digital data has its own limitations, but offers a valuable proxy to measure key characteristics of the knowledge economy.



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THANK YOU!

Sanna Ojanperä

E sanna.ojanpera@oii.ox.ac.uk

T [@SannaOjanpera](https://twitter.com/SannaOjanpera)

W geonet.oii.ox.ac.uk

www.oii.ox.ac.uk/people/sanna

Sources:

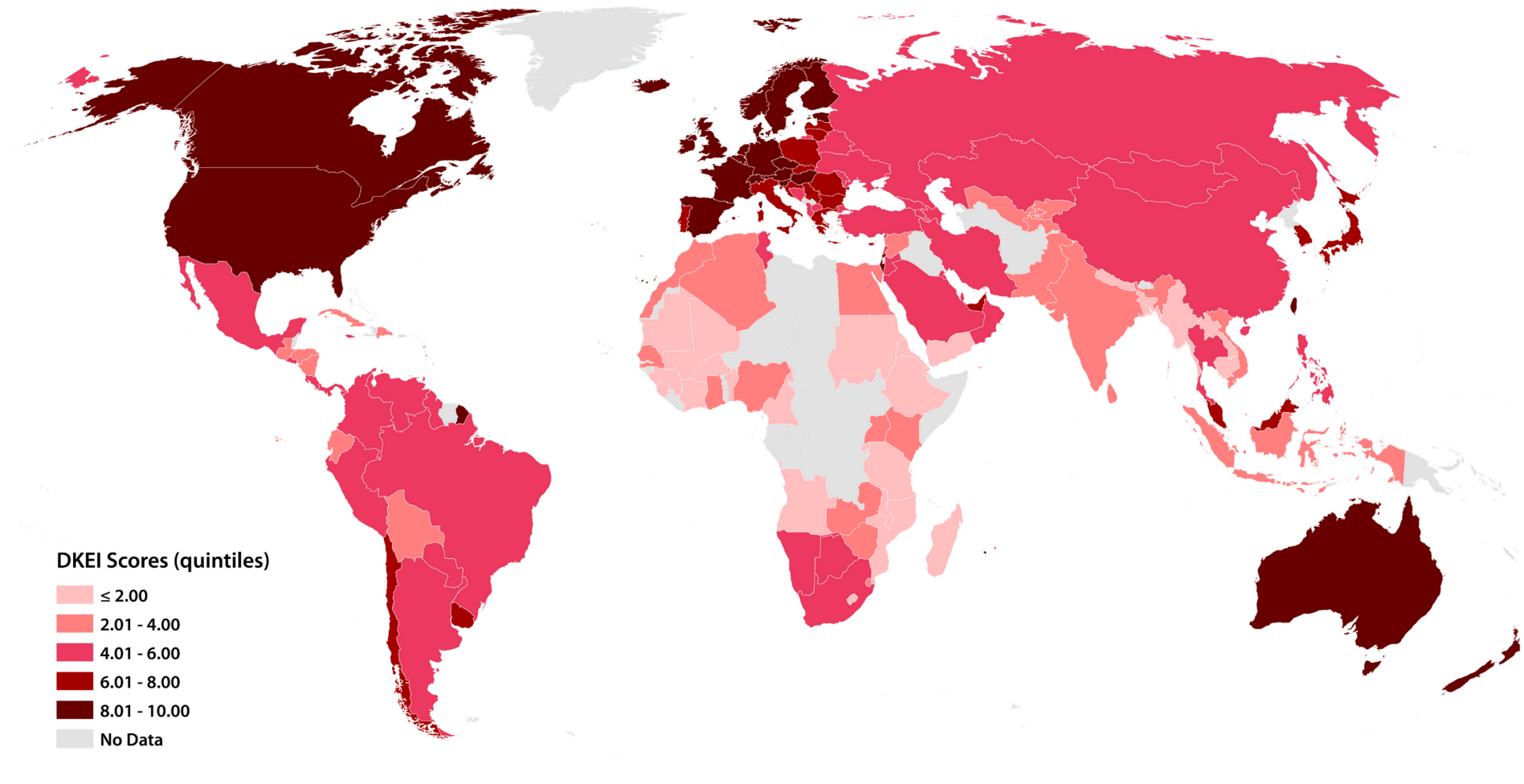
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Concepts: Knowledge Economy I

- While the concept of a knowledge economy does not have a clear universally accepted definition, a greater reliance in human capital over natural resources or material factors, and a focus on technology are amongst the central tenets of the term.

Concepts: Knowledge Economy II

- We define the knowledge economy as a combination of IT-enabled services, the quaternary sector of the economy, and more informal processes and practices of IT-mediated information production that tend to get left out of more formal models.

Concepts: Leapfrogging

- Forgoing investment in agricultural-intensive economies and labor-intensive economies, and even service-based economies while focusing more directly on knowledge-based industries
- Knowledge resources such as trade secrets, brands and expertise are as critical as other economic resources

Concepts: Africa's Statistical Tragedy

- The economic collapse of the 1980s and 1990s resulted in a large part of the economic activity moving to the 'informal economy'
- The continent has struggled to recover from the period of structural adjustment
- The need to collect appropriate data for poverty monitoring and results based management have left national statistical institutes with changing demands and agendas, but lacking implementation strategies in a context of already weak capacities

Data: TLDs

- To operationalize this variable, we sum the three different types of TLDs, including country-code TLDs (ccTLDs) such as .cm for Cameroon, generic TLDs (gTLDs) such as .com or .net, and internationalized TLDs (IDNccTLDs) that are ccTLDs in non-Latin script or alphabet, such as Arabic, or characters such as Chinese.

Countries Omitted Due to Inflated ccTLDs

| Country | ccTLD | Reason for Omission |
|--------------------------------|-------|--|
| Tuvalu | .tv | Used by the media industry |
| Federated States of Micronesia | .fm | Used by the media industry |
| Armenia | .am | Used by the media industry |
| Mauritius | .mu | Used by the music industry |
| Ascension Island | .ac | Used by education-related websites |
| Réunion | .re | Used by real estate agents |
| Samoa | .ws | Used as an abbreviation for 'web site' |
| Montenegro | .me | Used for personal websites |
| Cocos Islands | .cc | Used as an alternative to .com |
| Cameroon | .cm | Used as an alternative to .com to exploit typing errors |
| Niue | .nu | Means 'now' in Danish, Dutch, and Swedish |
| American Samoa | .as | The suffixes 'AS' and 'A/S' are used in some countries for joint stock companies |
| British Indian Ocean Territory | .io | Used by start-up companies |
| São Tomé and Príncipe | .st | Used worldwide in several ways |
| Tokelau | .tk | Can be registered free of charge |
| Mali | .ml | Can be registered free of charge |
| Gabon | .ga | Can be registered free of charge |
| Central African Republic | .cf | Can be registered free of charge |

Data: Scaling by Population

- We think that in the context of measuring and comparing countries' overall knowledge economy attainment, it is helpful to standardize the variables by the population. This weighted form of the KEI is also the default index configuration offered by the World Bank.
- However, we recognize that the unweighted variables measuring total numbers of digital participation and innovation tell an important story as well, since absolute size of resources matters where a critical mass of creativity and innovation is needed in order to facilitate exchange of ideas in a certain location. Further, populous economies such as China and India have a critical mass of innovative capacity, which is reflected less prominently when variables are scaled by population. However, as the Sub-Saharan African countries are the main focus of this study, we chose to use the weighted versions of both KEI and DKEI.

Method: Normalization

- To make the fifth sub index comparable to the existing four sub indices, we follow the KEI normalization procedure:
 - Record the raw data (u) for the digital participation variables
 - Rank the countries based on their absolute values (rank u) (Country with the highest value ranks 1, the second best 2, etc. Countries with the same value are allocated the same rank.)
 - Calculate the number of countries ranking higher than a particular country (N_h) for each country in the sample.
 - Use the following formula to normalize the scores for each country for each variable in relation to the total number of countries in the sample (N_c):



$$\text{Normalized } (u) = 10 * (1 - N_h / N_c)$$

Appropriate Normalization Procedure?



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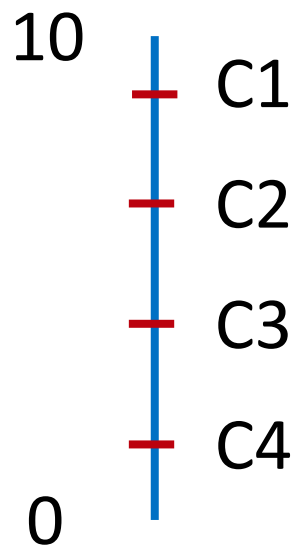
Appropriate Normalization Procedure?

KEI Normalization



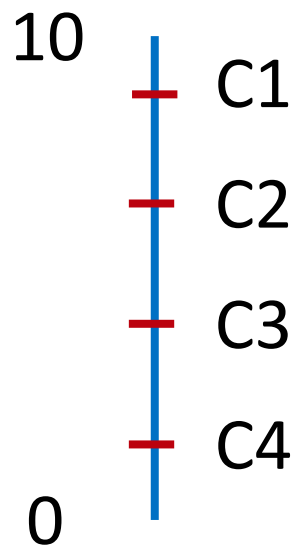
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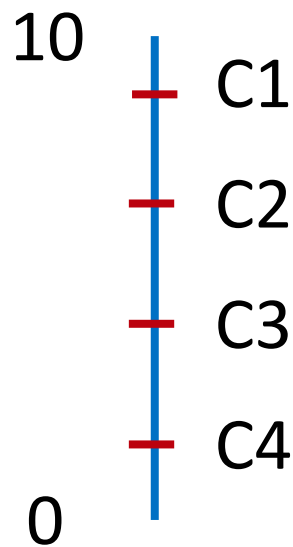


Min-Max Method



Appropriate Normalization Procedure?

KEI Normalization



Min-Max Method

