GEDI THE GLOBAL ENTREPRENEURSHIP AND DEVELOPMENT INSTITUTE

RIERC Regional Innovation and Entrepreneurship Research Center

Technical Annex for the DPE 2020 Dataset

Calculating the DPE 2020 index and the components scores

2020

According to our model we suggest a five-level composite indicator building following as (1) indicators (2) variables, (3) pillars, (4) sub-indices, and (5) the super-index. The super index is called the Digital Platform Economy index and its sub-indices are the four frameworks. The twelve components are called pillars. Pillars are the most important constituents of the model. Pillars are comprised from 24 variables, representing digital ecosystem (12) and entrepreneurship ecosystem (12). Variables are built from 61 indicators that are the elementary building blocks of DPE index.

We aimed to have the indicator available for at least 90% of the countries, but in five cases, we could not reach this goal. For 85 countries more than 95.1%, for 23 countries 90.1-95.0%, and for 8 countries 80.1-90.0% of the indicators are available. The results for these eight countries – Benin, Burundi, Hong Kong, Jamaica, Macedonia, Madagascar, Namibia, Taiwan – should be viewed with precaution. Variables were calculated from normalized indicator scores. Following the Global Entrepreneurship Index building methodology we provide the most important steps of calculation (Acs et al 2014).

All pillars contain two types of variables: One is representing the Digital Ecosystem (Digital technology and Users) and the other representing the Entrepreneurship Ecosystem (Institutions and Agents). The overall influence of these two types of variables is captured by multiplying the two components:

$$DPE\_pillar_{i,j} = DE\_variable_{i,j} * EE\_variable_{i,j} \qquad (1)$$

where

i=1……n, the number of countries
$DPE\_pillar_{i,j}$ represents the digital entrepreneurship ecosystem pillars, j= 1,…..12
$DE\_pillar_{i,j}$ represents the digital ecosystem pillars, j= 1,…..12
$EE\_pillar_{i,j}$ represents the entrepreneurship ecosystem pillars, j= 1,…..12

After the calculation of the raw pillar scores we normalized them using the distance methodology:

$$DPE\_pillar(norm)_{i,j} = \frac{DPE\_pillar_{i,j}}{\max DPE\_pillar_{i,j}} \qquad (2)$$

for all j= 1 ... 12, the number of pillars
where $DPE\_pillar(norm)_{i,k}$ is the normalized score value for country i and pillar j
$max\ \mathrm{DPE\_pillar}\ p_{i,j}$ is the maximum value for pillar j

When we calculate the normalized averages of the twelve pillars for the 116 countries, it ranges from 0.153 (Matchmaking) to 0.525 (Digital rights) with 0.361 overall average value. The different averages of the normalized values of the pillars imply that reaching the same pillar values requires different efforts and resources. Consequently, the effect of additional resources to achieve the same marginal improvement of the pillar values is different and it is problematic for using the pillar values to public policy purposes. The Average pillar adjustment methodology developed by Acs, Autio and Szerb (2014) reduces but not fully eliminates this problem.

The following equations (3a-3c) show the calculation steps.

First, we calculate the average value of the j=12 pillar:

$$\overline{DPE\_pillar(norm)}_{\mathrm{j}} = \frac{\sum_{\mathrm{i=1}}^{\mathrm{n}} \mathrm{DPE\_pillar(norm)_{i,j}}}{\mathrm{n}} \qquad \text{for all j} \qquad (3a)$$

where $\overline{\mathrm{DPE\_pillar(norm)}}_{\mathrm{j}}$ is the average value of all j=12 normalized pillars

We want to transform the $\mathrm{DPE\_pillar(norm)_{i,j}}$ values such that the potential values to be in the [0,1] range.

$$DPE\_pillar(equal)_{\mathrm{i,j}} = \mathrm{DPE\_pillar(norm)^{t}_{i,j}} \quad (3b)$$

where t is the "strength of adjustment", the t-th moment of $\mathrm{DEE\_pillar(norm)_j}$ is exactly the needed average, $\overline{\mathrm{DPE\_pıllar(equal)}}_{\mathrm{j}}$

We have to find the root of the following equation for t:

$$\sum_{\mathrm{i=1}}^{\mathrm{n}} \mathrm{DPE\_pillar(norm)^{t}_{I,j}} - \mathrm{n}\overline{\mathrm{DPE\_pıllar(equal)_j}} = 0 \quad (3c)$$

For solution, the Newton-Raphson method is used with an initial guess of 0. After obtaining t, the computations are straightforward.

After these transformations, the penalty for bottleneck methodology was used to create pillar-adjusted PFB values. A bottleneck is defined as the worst performing pillar or a limiting constraint in a particular country's digital entrepreneurship system. Here, bottleneck is defined as the lowest level of a particular pillar, relative to other pillars in a particular country. This notion of a bottleneck is important for policy purposes considering the systemic nature of DEE. The system perspective means that that pillars have an effect to one another. This interaction should be included in the calculation of the pillar, the sub-index and the DPE index scores. We consider the system being optimal if all the average adjusted pillar scores are the same for the particular country. Differences imply non-optimal use of the resources. Practically it means that after equalizing the pillar averages, the value of each pillar of a country is penalized by linking it to the score of the pillar with the weakest scores in that country. This simulates the notion of a bottleneck; if the weakest pillar were improved, the whole DPE Index would show a significant improvement.

We define our penalty function following as:

$$\mathrm{DPE\_penalized_{(i),j}} = 100 * \min \mathrm{DPE\_pillar(equal)_{(i),j}} + (1 - \mathrm{e}^{-(\mathrm{y_{(i)j}} - \min \mathrm{DPE\_pillar(equal)_{(i),j}})}) \quad (4)$$

where $\mathrm{DPE\_penalized_{i,j}}$ is the modified, post-penalty value of pillar j in country i
$\mathrm{DPE\_pillar(equal)_{i,j}}$ is the normalized value of index component j in country i
$\mathrm{DPE\_pillar(equal)_{min}}$ is the lowest value of $\mathrm{y_{i,j}}$ for country i.
i = 1, 2,……116 = the number of countries
j= 1, 2,…….12= the number of pillars

Note, that the multiplication by 100 is purely practical to get a 0–100-point scale instead of the 0–1 range.

Sub-index calculation is simple, just taking the arithmetic average of its PFB-adjusted pillars for that sub-index.

$$DIG_i = \sum_{j=1}^{3} \frac{DPE\_penalized_j}{3} \quad (5a)$$

$$DUC_i = \sum_{j=4}^{6} \frac{DPE\_penalized_j}{3} \quad (5b)$$

$$DMSP_i = \sum_{j=7}^{9} \frac{DPE\_penalized_j}{3} \quad (5c)$$

$$DTE_i = \sum_{j=10}^{12} \frac{DPE\_penalized_j}{3} \quad (5d)$$

where
DIG_i = Digital Technology Infrastructure score for country i
DUC_i = Digital User Citizenship score for country i
$DMSP_i$ = Digital Multi-sided Platform score for country i, and
DTE_i = Digital Technology Entrepreneurship score for country i

Finally, the Digital Platform Economy index (DPE) score is calculated as the simple arithmetic average of the four sub-indices.

$$DPE_i = \frac{1}{4}(DIG_i + DUC_i + DMSP_i + DTE_i) \quad (6)$$

Where DPE_i is the Digital Platform Economy index score for country i.