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Iliana Olivié, Manuel Gracia Santos

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Iliana Olivié | Senior analyst and coordinator of the Elcano Global Presence Index Project, Elcano Royal Institute | @iolivie

Manuel Gracia Santos | Analyst on the Elcano Global Presence Index Project, Elcano Royal Institute | @mgraciasn

7. Model

Considering all the elements described in the previous sections, the Elcano Global Presence Index model would be as follows:

$$\mathrm{IPG_{i,t}} = \alpha_E \mathrm{IPE_{i,t}} + \alpha_M \mathrm{IPM_{i,t}} + \alpha_S \mathrm{IPS_{i,t}} \qquad [1]$$

The value of a country's record in global presence ($\mathrm{IPG_{I,t}}$) is the result of the weighted sum of its record in economic ($\mathrm{IPE_{I,t}}$), military ($\mathrm{IPM_{I,t}}$) and soft presence ($\mathrm{IPS_{I,t}}$), multiplied by their respective coefficients ($\alpha_E, \alpha_M, \alpha_S$; being $\alpha_E + \alpha_M + \alpha_S = 1$)

$$\mathrm{IPE_{i,t}} = \alpha_{EN} EN'_{i,t} + \alpha_{PG} PG'_{i,t} + \alpha_{MA} MA'_{i,t} + \alpha_{SE} SE'_{i,t} + \alpha_I I'_{i,t} \qquad [2]$$

The value of a country's record in economic presence ($\mathrm{IPE_{i,t}}$) is the result of the weighted sum of transformed economic variables (*EN'*, *PG'*, *MA*', *SE', I'*) multiplied by their respective coefficients ($\alpha_{EN}, \alpha_{PG}, \alpha_{MA}, \alpha_{SE}, \alpha_I$); with $\alpha_E = \alpha_{EN} + \alpha_{PG} + \alpha_{MA} + \alpha_{SE} + \alpha_I$.

The transformed variables of the economic dimension, in terms of the GDP of each country and year ($\mathrm{PIB_{i,t}}$), are obtained as follows:

$$EN'_{i,t} = \frac{\mathrm{EN_{i,t}} - \mathrm{EN_{MIN}}}{\mathrm{EN_{MAX}} - \mathrm{EN_{MIN}}} * \frac{\mathrm{GDP_{i,t}}}{\frac{\Sigma_i^n \mathrm{GDP_t}}{n}} * 1000 \qquad [3]$$

$$PG'_{i,t} = \frac{\mathrm{PG_{i,t}} - \mathrm{PG_{MIN}}}{\mathrm{PG_{MAX}} - \mathrm{PG_{MIN}}} * \frac{\mathrm{GDP_{i,t}}}{\frac{\Sigma_i^n \mathrm{GDP_t}}{n}} * 1000 \qquad [4]$$

$$MA'_{i,t} = \frac{\mathrm{MA_{i,t}} - \mathrm{MA_{MIN}}}{\mathrm{MA_{MAX}} - \mathrm{MA_{MIN}}} * \frac{\mathrm{GDP_{i,t}}}{\frac{\Sigma_i^n \mathrm{GDP_t}}{n}} * 1000 \qquad [5]$$

$$SE'_{i,t} = \frac{\mathrm{SE_{i,t}} - \mathrm{SE_{MIN}}}{\mathrm{SE_{MAX}} - \mathrm{SE_{MIN}}} * \frac{\mathrm{GDP_{i,t}}}{\frac{\Sigma_i^n \mathrm{GDP_t}}{n}} * 1000 \qquad [6]$$

$$I'_{i,t} = \frac{\mathrm{I_{i,t}} - \mathrm{I_{MIN}}}{\mathrm{I_{MAX}} - \mathrm{I_{MIN}}} * \frac{\mathrm{GDP_{i,t}}}{\frac{\Sigma_i^n \mathrm{GDP_t}}{n}} * 1000 \qquad [7]$$

where $EN_{i,t} = \frac{Xen_{i,t}}{GDP_{i,t}}$; $PG_{i,t} = \frac{Xpg_{i,t}}{GDP_{i,t}}$; $MA_{i,t} = \frac{Xma_{i,t}}{GDP_{i,t}}$; $SE_{i,t} = \frac{Xse_{i,t}}{GDP_{i,t}}$; $I_{i,t} = \frac{FDI_{i,t}}{GDP_{i,t}}$, with '$X_{en}$', '$X_{pg}$', '$X_{ma}$', '$X_{se}$' being exports of energy goods, primary goods, manufactures and services, respectively, and FDI the stock of foreign investment of country i in year t.
The value of military presence ($IPM_{i,t}$) is the result of the weighted sum of the transformed military variables (*TR'*, *ME'*) multiplied by their respective coefficients (α_{TR}, α_{ME}); with $\alpha_{TR} + \alpha_{ME} = \alpha_M$).

$$IPM_{i,t} = \alpha_T TR'_{i,t} + \alpha_{ME} ME'_{i,t} \qquad [8]$$

The transformed variables of the military dimension, in terms of the population of each country and year ($POP_{i,t}$), are obtained as follows:

$$TR'_{i,t} = \frac{TR_{i,t} - TR_{MIN}}{TR_{MAX} - TR_{MIN}} * \frac{POP_{i,t}}{\frac{\Sigma_i^n POP}{n}} * 1000 \qquad [9]$$

$$ME'_{i,t} = \frac{ME_{i,t} - ME_{MIN}}{ME_{MAX} - ME_{MIN}} * \frac{POP_{i,t}}{\frac{\Sigma_i^n POP}{n}} * 1000 \qquad [10]$$

where $TR_{i,t} = \frac{tr_{i,t}}{POP_{i,t}}$ y $ME_{i,t} = \frac{me_{i,t}}{POP_{i,t}}$; with 'tr' being the number of troops deployed abroad by country i in year t, and 'me' the weighted sum of the different types of military equipment ($me_{i,t} = \beta_{AC} AC_{i,t} + \beta_{AS} AS_{i,t} + \beta_F F_{i,t} + \beta_C C_{i,t} + \beta_S S_{i,t} + \beta_{TA} TA_{i,t} + \beta_{CA} CA_{i,t}$; with 'AC' being the number of aircraft carriers, 'AS' of amphibious ships, 'F' of frigates, 'C' of cruisers, 'S' of nuclear-powered submarines, 'TA' of transport aircraft and 'CA' of air tankers).

As explained above, the weighting coefficients of the different types of equipment ('β_a') are obtained from the calculation of equivalences between the 2010 records and equalling the sum of the coefficients to 1000 ($\beta_{AC} + \beta_{AS} + \beta_F + \beta_C + \beta_S + \beta_{TA} + \beta_{CA} = 1000$);

$$\beta_a = \frac{\frac{\Sigma_{i,2010}^n EQ}{\Sigma_{i,2010}^n EQ_a}}{\Sigma_{i,2010}^n \frac{\Sigma_{i,2010}^n EQ}{\Sigma_{i,2010}^n EQ_a}} * 1000 \qquad [11]$$

with 'EQ' being the simple addition of the different types of equipment ($EQ = AC_t + AS_t + F_t + C_t + S_t + TA_t + CA_t$).
The record of a country in soft presence ($IPS_{i,t}$) is the result of the weighted sum of the transformed soft variables (*MI'*, *TO'*, *SP'*, *CUL'*, *IN'*, *TEC'*, *SC'*, *EDU'*, *CO'*, *CC'*) multiplied by their respective coefficients (α_{MI}, α_{TO}, α_{SP}, α_{CUL}, α_{IN}, α_{TEC}, α_{SC}, α_{EDU}, α_{CO}, α_{CC}),

$$IPS_{i,t} = \alpha_{MI} MI'_{i,t} + \alpha_{TO} TO'_{i,t} + \alpha_{SP} SP'_{i,t} + \alpha_{CUL} CUL'_{i,t} + \alpha_{IN} IN'_{i,t} + \alpha_{TEC} TEC'_{i,t} + \alpha_{SC} SC'_{i,t} + \alpha_{EDU} EDU'_{i,t} + \alpha_{CO} CO'_{i,t} + + \alpha_{CC} CC'_{i,t} \qquad [12]$$

where $\alpha_{MI} + \alpha_{TO} + \alpha_{SP} + \alpha_{CUL} + \alpha_{IN} + \alpha_{TEC} + \alpha_{SC} + \alpha_{EDU} + \alpha_{CO} + \alpha_{CC} = \alpha_S$, and obtaining the transformed variables, in terms of the population of each country and years ($POP_{i,t}$), as follows:

$$MI'_{i,t} = \frac{MI_{i,t} - MI_{MIN}}{MI_{MAX} - MI_{MIN}} * \frac{POP_{i,t}}{\frac{\Sigma_i^n POP}{n}} * 1000 \qquad [13]$$

where $MI_{i,t} = \frac{mi_{i,t}}{POP_{i,t}}$, with 'mi' being the stock of immigrants in country i in year t.

$$TO'_{i,t} = \frac{TO_{i,t} - TO_{MIN}}{TO_{MAX} - TO_{MIN}} * \frac{POP_{i,t}}{\frac{\Sigma_i^n POP}{n}} * 1000 \qquad [14]$$

where $TO_{i,t} = \frac{to_{i,t}}{POP_{i,t}}$, with 'to' being the number of international tourist arrivals in country i in year t.

$$SP'_{i,t} = \frac{SP_{i,t} - SP_{MIN}}{SP_{MAX} - SP_{MIN}} * \frac{POP_{i,t}}{\frac{\Sigma_i^n POP}{n}} * 1000 \qquad [15]$$

with 'SP' being the weighted sum of the record obtained in the Olympic medal standings subcomponent and in the professional soccer subcomponent, as explained in the corresponding section.

$$SP_{i,t} = \left(0.75 * \frac{OM_{i,t}}{\Sigma_i^n OM_t} + 0.25\left(\frac{MFP_{i,t}}{\Sigma_i^n MFP_t} + \frac{FFP_{i,t}}{\Sigma_i^n FFP_t} + \frac{FCP_{i,t}}{\Sigma_i^n FCP_t}\right)\right) * 1000 \qquad [16]$$

where $OM_{i,t} = \frac{om_{i,t}}{POP_{i,t}}$, $MFP_{i,t} = \frac{mfp_{i,t}}{POP_{i,t}}$, $FFP_{i,t} = \frac{ffp_{i,t}}{POP_{i,t}}$, $FCP = \frac{fcp_{i,t}}{POP_{i,t}}$, with 'om', 'mfp', 'ffp' and 'fcp' being respectively the number of medals in the Olympics, the FIFA points of the men's national soccer team, the FIFA points of the women's national soccer team, and the points of the soccer clubs, respectively, of country i in year t.

$$CUL'_{i,t} = \left(0.5 * \left(\frac{CS_{i,t} - CS_{MIN}}{CS_{MAX} - CS_{MIN}}\right) + 0.5 * \left(\frac{CG_{i,t} - CG_{MIN}}{CG_{MAX} - CG_{MIN}}\right)\right) * \frac{POP_{i,t}}{\frac{\Sigma_i^n POP}{n}} * 1000 \qquad [17]$$

where $CS_{i,t} = \frac{cs_{i,t}}{POP_{i,t}}$, $CG_{i,t} = \frac{cg_{i,t}}{POP_{i,t}}$, with 'cs' and 'cg' being respectively exports of services and cultural goods.

$$IN'_{i,t} = \left(0{,}5 * \left(\frac{INT_{i,t} - INT_{MIN}}{INT_{MAX} - INT_{MIN}}\right) + 0{,}5 * \left(\frac{NOT_{i,t} - NOT_{MIN}}{NOT_{MAX} - NOT_{MIN}}\right)\right) * \frac{POP_{i,t}}{\frac{\Sigma_i^n POP}{n}} * 1000 \qquad [18]$$

where $INT_{i,t} = \frac{int_{i,t}}{POP_{i,t}}$, $NOT_{i,t} = \frac{not_{i,t}}{POP_{i,t}}$, with 'int' and 'not' being the bandwidth of Internet access and the number of mentions in the main international news agencies of country i in year t.

$$TEC'_{i,t} = \left(0.5 * \left(\frac{PAT_{i,t} - PAT_{MIN}}{PAT_{MAX} - PAT_{MIN}}\right) + 0.5 * \left(\frac{ROY_{i,t} - ROY_{MIN}}{ROY_{MAX} - ROY_{MIN}}\right)\right) * \frac{POP_{i,t}}{\frac{\Sigma_i^n POP}{n}} * 1000 \qquad [19]$$

where $PAT_{i,t} = \frac{pat_{i,t}}{POP_{i,t}}, ROY_{i,t} = \frac{roy_{i,t}}{POP_{i,t}}$, with 'pat' y 'roy' being the number of patents oriented abroad and the total income received from abroad for the use of intellectual property of country i in year t.

$$SC'_{i,t} = \frac{SC_{i,t} - CI_{MIN}}{SC_{MAX} - SC_{MIN}} * \frac{POP_{i,t}}{\frac{\Sigma_i^n POP}{n}} * 1000 \qquad [20]$$

where $SC_{i,t} = \frac{sc_{i,t}}{POP_{i,t}}$, with 'sc' being the number of scientific articles, notes and reviews published in year t.

$$EDU'_{i,t} = \frac{EDU_{i,t} - EDU_{MIN}}{EDU_{MAX} - EDU_{MIN}} * \frac{POP_{i,t}}{\frac{\Sigma_i^n POP}{n}} * 1000 \qquad [21]$$

where $EDU_{i,t} = \frac{edu_{i,t}}{POP_{i,t}}$, with 'edu' being the number of international students received by country i in year t.

$$CO'_{i,t} = \frac{CO_{i,t} - CO_{MIN}}{CO_{MAX} - CO_{MIN}} * \frac{POP_{i,t}}{\frac{\Sigma_i^n POP}{n}} * 1000 \qquad [22]$$

where $CO_{i,t} = \frac{co_{i,t}}{POP_{i,t}}$, with 'co' being the volume of gross official development assistance disbursed by country i in year t.

$$CC' = \left(0.5 * \left(\frac{EM_{i,t} - EM_{MIN}}{EM_{MAX} - EM_{MIN}}\right) + 0.5 * \left(\frac{RE_{i,t} - RE_{MIN}}{RE_{MAX} - RE_{MIN}}\right)\right) * \frac{POP_{i,t}}{\frac{\Sigma_i^n POP}{n}} * 1000 \qquad [23]$$

where $EM_{i,t} = \frac{em_{i,t}}{POB_{i,t}}$ y $RE_{i,t} = \frac{re_{i,t}}{POB_{i,t}}$, with 'em' being the volume of greenhouse gas emissions and 're' the installed capacity of renewable energy generation in country i and year t.