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Global Migration Index

Cian Ashby

Dundalk Institute of Technology

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Introduction

What is the Project?

This is a project aimed towards the creation of a composite index, which is intended to evaluate countries under the question: "What makes a country more or less attractive to live in?". It should roughly relate to the net migration of a country, and help to compare countries with each other based on their overall push/pull on migration.

Importance to the Public

This is an important question to answer for members of countries, specifically their governmental organisations and those who would inhabit the country. The main outcome I envision for an index like this is to support focus towards the most important areas in generating positive results for those living in a country:

- Governments can receive guidance through examining the individual aspects of a country that make up this index. Insights on how these factors impact whether people come or go will help them understand what aspects of their country are most important to support and fix, if their desire is to make it appealing to those deciding whether to move country or not.
- Many migrants compare different options in their decision to move country, trying to envision where they will be successful in settling down and building a happy life.
- Citizens of a country may desire improvement in areas important to them, if they are to consider staying in their country a comfortable and worthwhile thing to do.

Personal Importance

The project is also fuelled by a personal curiosity in this, as I want to move out of Ireland for my own reasons. I would like to see what factors contribute to the decision of others in movement, as well as what countries seem to be most appealing overall for people to begin their new life in.

Considered Sub-groups

From decisions based on external research and consideration of data below, I have narrowed down these sub-indices, which I expect to be most ideal.

- ECMI: Economic Migration Index - A country's push/pull for migration based on its economic state
- ENMI: Environmental Migration Index - A country's push/pull for migration based on the current state of, and ongoing treatment of, its environment
- PMI: Political Migration Index - A country's push/pull for migration based on its governmental qualities
- SMI: Social Migration Index - A country's push/pull for migration based on its demographics, and how well it supports the groups and individuals living within

Their weighting in the resulting composite index will be based on their frequency in research compared to the other sub-groups.

Selection Criteria for Indicators

The indicators used are to be considered by experts in literature as either potential, or already determined, incoming or outgoing migratory factors. The indicators included will have the ability to be compared on the basis of entire countries, indicators focused on individuals (e.g. the reason for moving, their complex cultural attributed) will not be considered for this particular, country-wide project.

Theoretical Framework

To get an idea of the sub-indices I would use, I used the search term “migration factors” in google scholar. From there, I picked out literature which contained distinguishable perspectives on migration, which could be turned into relevant sub-indices.

| Study Name | Migration Factors Focused On | Mentioned Factors |
|--|---|--|
| Push and Pull Factors of Migration (Perkins 2010) | <ul style="list-style-type: none">• Economic• Social | |
| The environmental factor in migration dynamics – a review of African case studies (Jónsson 2010) | <ul style="list-style-type: none">• Environmental | <ul style="list-style-type: none">• Political• Economic• Social• Cultural |
| Comparing Push and Pull Factors Affecting Migration (Urbański 2022) | <ul style="list-style-type: none">• Economic• Social• Political | |
| The Influence of Factors of Migration on the Migration Status of Rural-Urban Migrants in Dhaka, Bangladesh (Ishtiaque and Ullah 2013) | <ul style="list-style-type: none">• Social | <ul style="list-style-type: none">• Economic |
| Socio-Economic Factors Associated with Urban-Rural Migration in Nigeria: A Case Study of Oyo State, Nigeria (Adewale 2005) | <ul style="list-style-type: none">• Social• Economic | <ul style="list-style-type: none">• Cultural• Environmental• Political |
| Factors determining international and regional Migration in Europe (Fouarge and Ester 2007) | <ul style="list-style-type: none">• Social• Cultural• Economic | |

From consideration of the literature above, and how feasible it is for their listed factors may be extracted, I chose the following factors of migration, which the sub-indices would be based on:

- Economic
- Environmental
- Political
- Social

Afterwards, I conducted a deeper literature review aimed at getting an idea of the indicators related to specific factors. This is listed in further detail within the file implementing my composite index.

Once I determined the indicators I ought to use, I set out to collect this data.

Data Selection

| Sub-Index | Name | Source |
|---------------|--|---|
| N/A | Net migration | (World Bank Group 2025) |
| Economic | GDP Current US\$ | (World Bank Group 2025) |
| Economic | Taxes on income, profits and capital gains (% of total taxes) | (World Bank Group 2025) |
| Social | Population density (people per sq. km of land area) | (World Bank Group 2025) |
| Economic | GDP growth (annual %) | (World Bank Group 2025) |
| Social | Access to electricity (% of population) | (World Bank Group 2025) |
| Economic | Current health expenditure per capita (current US\$) | (World Bank Group 2025) |
| Social | Birth rate, crude (per 1,000 people) | (World Bank Group 2025) |
| Social | Population ages 20-24, female (% of female population) | (World Bank Group 2025) |
| Social | Population ages 20-24, male (% of male population) | (World Bank Group 2025) |
| Social | Individuals using the Internet (% of population) | (World Bank Group 2025) |
| Social | Death rate, crude (per 1,000 people) | (World Bank Group 2025) |
| Environmental | Total greenhouse gas emissions excluding LULUCF (Mt CO2e) | (World Bank Group 2025) |
| Environmental | Renewable energy consumption (% of total final energy consumption) | (World Bank Group 2025) |
| Environmental | PM2.5 air pollution, mean annual exposure (micrograms per cubic meter) | (World Bank Group 2025) |
| Political | Control of Corruption: Estimate | (World Bank Group 2024) |
| Political | Government Effectiveness: Estimate | (World Bank Group 2024) |
| Political | Political Stability and Absence of Violence/Terrorism: Estimate | (World Bank Group 2024) |
| Political | Regulatory Quality: Estimate | (World Bank Group 2024) |
| Political | Rule of Law: Estimate | (World Bank Group 2024) |
| Political | Voice and Accountability: Estimate | (World Bank Group 2024) |

Imputation of Missing Data

Cluster Imputation for Tax Indicator

For the indicator “Taxes on income, profits and capital gains (% of total taxes)”, a different approach was taken due to it’s high value nature.

K-means clustering was used, along with the highest correlating indicators to tax, to impute the missing data by referencing average tax values of similar countries.

The result of this was observed to be a 44% increase of the final migration index's R-Squared Adjusted, from 0.100 to 0.144.

Imputation of General Data

The process of imputing general missing data was performed based on three stages:

The first stage of this process was to grab the data from the previous and next year, then set the current year's missing data as the average.

The second stage, progressed to when one of the neighbouring years was missing data, was to simply copy the data from the neighbouring year that did have data present.

Finally, in the scenario where both neighbouring years have no data, use of the column's median would be resorted to once again

Multivariate Analysis

Analysis of the indicators compared to a country's net migration revealed that the highest correlation was from the indicator of a country's GDP, at 0.427. A medium positive correlation.

The rest of the indicators were below 0.4 correlation, meaning all of them were weak correlations, and would normally be dropped. In this case, could not afford to do so, as I did not have a sufficient amount of correlating indicators of strong/medium strength.

Approach Taken

The approach I took was as follows:

1. Perform independent-to-dependent analysis, and drop the indicators with the lowest correlations and statistical significances, up until the point where dropping the next indicator up would leave one of the sub-indices with no indicators.
 - i. The cut-off point for statistical significance was a p-value lower than 0.05
 - ii. The desired cut-off point for correlations, below 0.4, could not be used
2. Perform independent-to-independent analysis to determine what variables featured multicollinearity
 - i. Multicollinearity was assumed at a correlation greater than or equal to 0.7

The figures coming from my analysis of these variables, consisting of all pairings of independent and/or dependent variables are listed in tables within the next two pages.

Independent-To-Dependent Results

Rows highlighted in **red** were removed due to low statistical significance

Rows highlighted in **yellow** were removed as they were of low correlation, and could be removed without eliminating the existence of a desired sub-index

| X Variable | Y Variable | Correlation | P-Value |
|--|---------------|----------------------|------------------------|
| GDP (current US\$) | Net Migration | 0.4268676843913936 | 1.742371488197784e-10 |
| Current health expenditure per capita (current US\$) | Net Migration | 0.3436717537381353 | 4.5338433462452925e-07 |
| Taxes on income, profits and capital gains (% of total taxes) | Net Migration | 0.2953381574192319 | 1.7154723522094168e-05 |
| PM2.5 air pollution, mean annual exposure (micrograms per cubic meter) | Net Migration | -0.26499802424414975 | 0.00012309952227867224 |

| | | | |
|---|---------------|-----------------------|------------------------|
| Regulatory Quality: Estimate | Net Migration | 0.2637400685113876 | 0.00013292959836889553 |
| Rule of Law: Estimate | Net Migration | 0.23131990069709893 | 0.0008465066658026153 |
| Government Effectiveness: Estimate | Net Migration | 0.22304119689697788 | 0.001306591648701091 |
| Control of Corruption: Estimate | Net Migration | 0.21665053649714233 | 0.0018076620629482827 |
| Voice and Accountability: Estimate | Net Migration | 0.21340622237305137 | 0.0021241674375022767 |
| Individuals using the Internet (% of population) | Net Migration | 0.19017801847923319 | 0.0063093342797983275 |
| Population ages 20-24, female (% of female population) | Net Migration | -0.1898873120447306 | 0.006391230119210192 |
| Political Stability and Absence of Violence/Terrorism: Estimate | Net Migration | 0.1894501272547114 | 0.006516178862047976 |
| Population ages 20-24, male (% of male population) | Net Migration | -0.15773426638844418 | 0.02389831308679752 |
| GDP growth (annual %) | Net Migration | -0.14668978321093112 | 0.035834340754298304 |
| Birth rate, crude (per 1,000 people) | Net Migration | -0.13018471720804692 | 0.06281632659801673 |
| Total greenhouse gas emissions excluding LULUCF (Mt CO2e) | Net Migration | 0.12852873963025546 | 0.06626543437228835 |
| Death rate, crude (per 1,000 people) | Net Migration | 0.10981306361159911 | 0.11701802952865527 |
| Renewable energy consumption (% of total final energy consumption) | Net Migration | -0.08853510534268441 | 0.20681963725519206 |
| Access to electricity (% of population) | Net Migration | 0.02088092546130591 | 0.7663339442162369 |
| Population density (people per sq. km of land area) | Net Migration | -0.013330682266792545 | 0.8495382216070834 |

Independent-To-Independent Results

As the file containing this data was lengthy, what will be shown below are only the variables that featured multicollinearity. For a full view of these IV/IV analyses, please refer to [independent_independent_analysis.csv](#)

“Regulatory Quality: Estimate”, highlighted in **yellow** was considered further due to it’s multicollinearity, but progressed to the final index

Indicators highlighted in **red** were considered further due to their multicollinearity, but were eventually removed

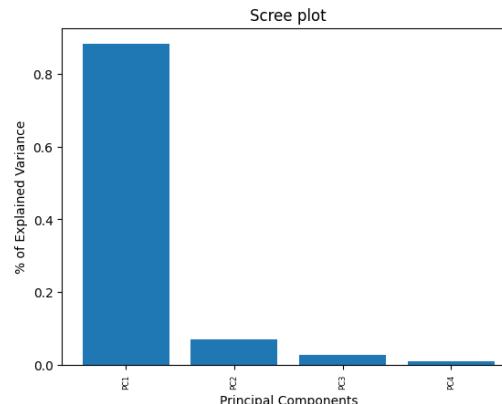
| X Variable | Y Variable | Correlation | P-Value |
|--|------------------------------------|--------------------|------------------------|
| Control of Corruption: Estimate | Rule of Law: Estimate | 0.9428341463715826 | 7.916957593691944e-99 |
| Government Effectiveness: Estimate | Rule of Law: Estimate | 0.936020624074909 | 5.134470320178148e-94 |
| Government Effectiveness: Estimate | Regulatory Quality: Estimate | 0.92191067416344 | 1.5120619909730145e-85 |
| Government Effectiveness: Estimate | Control of Corruption: Estimate | 0.913275832719441 | 4.057736166085321e-81 |
| Regulatory Quality: Estimate | Rule of Law: Estimate | 0.9060976263100429 | 8.941806007217348e-78 |
| Regulatory Quality: Estimate | Control of Corruption: Estimate | 0.8552997756024319 | 7.021330302465653e-60 |
| Rule of Law: Estimate | Voice and Accountability: Estimate | 0.7995182174451233 | 7.991056994427714e-47 |
| Individuals using the Internet (% of population) | Government Effectiveness: Estimate | 0.7979098843121405 | 1.6453991851716961e-46 |
| Control of Corruption: Estimate | Voice and Accountability: Estimate | 0.7840383888802254 | 6.437963036663316e-44 |
| Regulatory Quality: Estimate | Voice and Accountability: Estimate | 0.7569200974868601 | 2.3062158564430092e-39 |
| Individuals using the Internet (% of population) | Regulatory Quality: Estimate | 0.7540358129057909 | 6.487405322704896e-39 |
| Individuals using the Internet (% of population) | Rule of Law: Estimate | 0.7307393216669218 | 1.6793121269643898e-35 |
| Government Effectiveness: Estimate | Voice and Accountability: Estimate | 0.7287249433294252 | 3.1880270136328246e-35 |

Normalization

The method I chose to normalize my data was to set it from 0 to 1. Normalization opened the door for performing PCA on this step, which I used to try and handle the political variables, which all had some degree of multicollinearity.

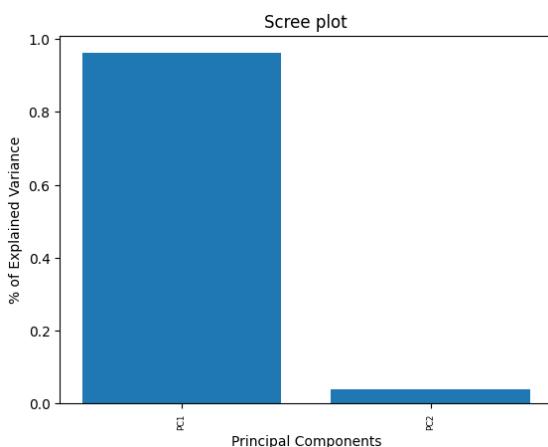
PCA

I started by performing PCA on all political variables, to explain 99% of the variance in the data.



The result was an R-squared of 0.0135

One of the better results I got from PCA was to just consider the political indicators "Government Effectiveness: Estimate" and "Regulatory Quality: Estimate"



The result was an R-squared of 0.0386

I opted to leave PCA out of the final index, as its R-squared is consistently lower than the political sub-index as it stands now. It would also impact the transparency of my final index, as one cannot see exactly how much a particular indicator has contributed to the final index.

Weighting and Aggregation

Due to the existence of a net migration indicator, which has helped guide the development of this index along the way, I was able to get each independent variable's correlation to it.

For weighting the contribution of indicators towards their parent sub-indices, I took the correlation of the indicator to net migration, and divided it by the total of correlations that all indicators of that sub-index had. The indicator would be multiplied by this weighting before being added to the sub-index.

For weighting the sub-indices before using them to form the composite index, I used a similar method. The only difference was that I got the R-Squared Adjusted of the sub-index towards the net migration indicator, rather than the correlation.

Links to Other Indicators

Throughout the project, I was able to base the development of this composite index off the net migration of each country considered. Once my composite index was complete, I was able to compare it to the pre-existing figure of people coming and going from a country in a given year.

I have made the following three attempts at creating this composite index, differing in indicators and/or development approach.

First Attempt

My first attempt at this project, in the file attempt_1_main.ipynb, consisted of the following for the composite index:

Economic sub-index

- Current health expenditure (% of GDP)
- GDP per capita (current US\$)

Political sub-index

- Regulatory Quality (rq)
- Control of Corruption (cc)
- Political Stability and Absence of Violence/Terrorism (pv)

Social sub-index

- Population ages 20-24, female (% of female population)

Environmental sub-index

- PM2.5 air pollution, mean annual exposure (micrograms per cubic meter)

This resulted in a model with an **R-Squared Adjusted of 0.08**

Second Attempt

Economic sub-index

- Current health expenditure (% of GDP)
- GDP per capita (current US\$)

Political sub-index

- Regulatory Quality: Estimate
- Voice and Accountability: Estimate

Social sub-index

- Population ages 20-24, female (% of female population)
- Individuals using the Internet (% of population)

Environmental sub-index

- PM2.5 air pollution, mean annual exposure (micrograms per cubic meter)

This resulted in a model with an **R-Squared Adjusted** of **0.04**

- the new political sub-index shifted it from **.084 -> .08**
- afterwards, the new social sub-index shifted it from **.08 -> .04**

Current Index

My first attempt at this project, in the file attempt_1_main.ipynb, consisted of the following for the composite index:

Economic sub-index

- Current health expenditure (% of GDP)
- GDP per capita (current US\$)
- Taxes on income, profits and capital gains (% of total taxes)

Political sub-index

- Regulatory Quality: Estimate

Social sub-index

- Population ages 20-24, female (% of female population)

Environmental sub-index

- PM2.5 air pollution, mean annual exposure (micrograms per cubic meter)

This initially resulted in a model with an **R-Squared Adjusted** of **0.100**

Though it was initially plagued by issues, I was finally able to introduce the imputation of tax values via clustering, which would fill in tax values in a more informed way before being fed into the final index.

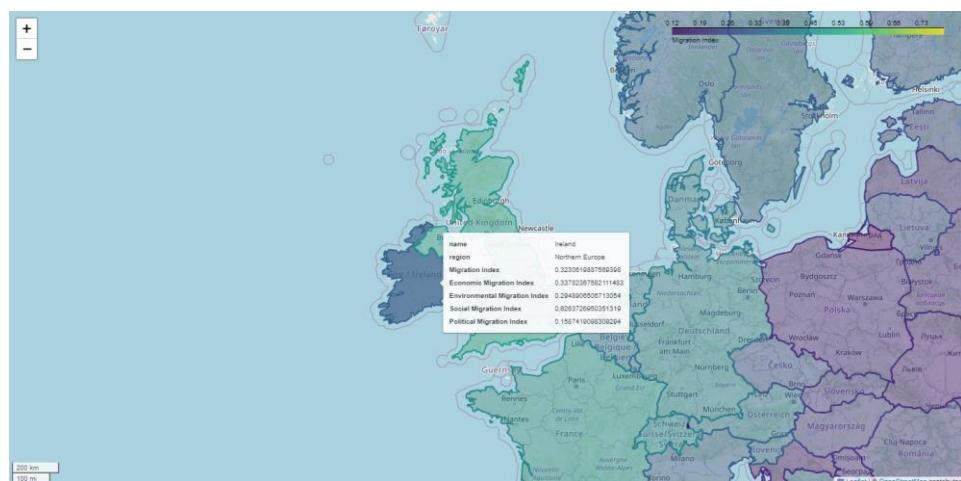
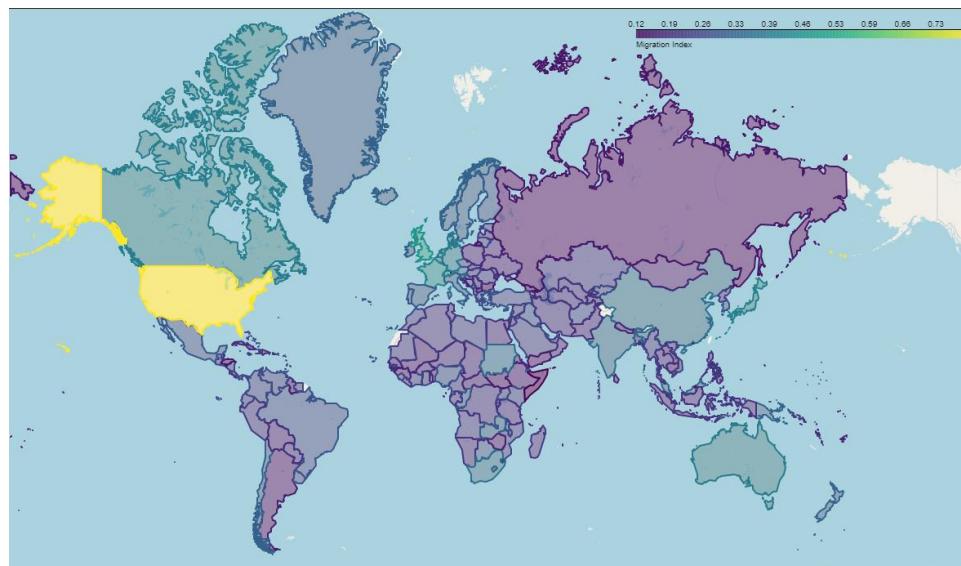
As a result of this, the final R-squared of the composite index reached **0.144**, a welcome improvement over previous iterations.

Visualization of the Results

Please note: The visualization methods do not seem to be supported by GitHub's display of .ipynb files. You will need to download the project and its dependencies to see these

Interactive Map

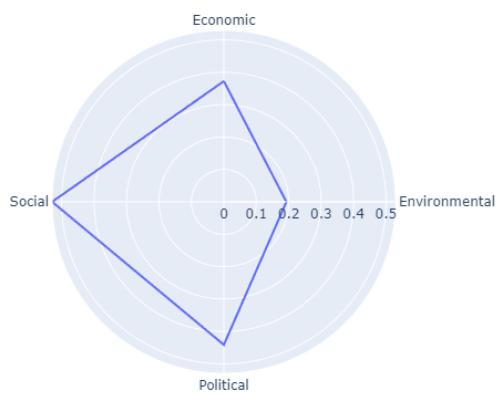
To visualize the entire globe at a glance, for the ease of determining where countries are ranked highest, as well as quickly navigating to a specific country in question, I implemented an interactive map.



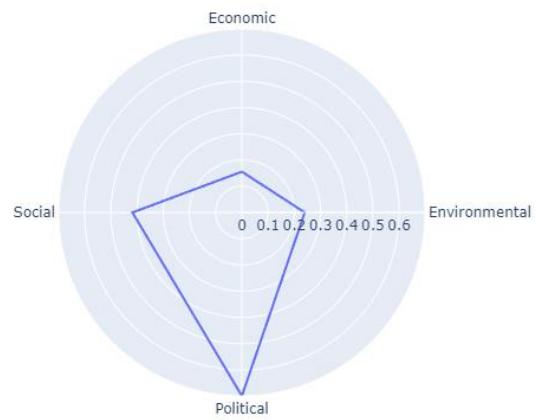
The countries on this map may be hovered over to view their index scores, including the individual sub-indices that represent different aspects of the country.

Radar Chart

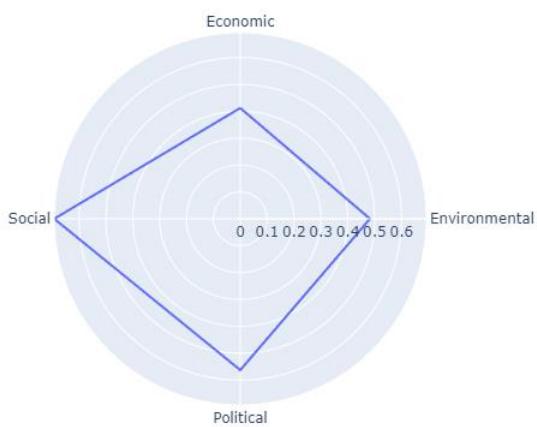
The radar charts below provide a great way to visualize a global region's average scoring under each sub-index, so one can see at a glance where regions do strongly, and where they will need to improve, in order to be most appealing to migrants.



Southern Europe



Southern Africa



South-Eastern Asia



Northern America

References

These are the references I have used throughout my project, organized by the section they feature in.

Theoretical Framework

These are sources I looked through to determine adequate sub-indices and indicators from expert analysis of migration. For the most part, skimmed through the literature to analyse the frequency of certain indicators under determined sub-index categories.

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Weighting and Aggregation

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Links to Other Indicators

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