

Macroeconomic SDG Forecasts for the KSA,

Background Paper for KSA CCA

Draft, February 2021, Austin Hamilton¹ & Aljaz Kuncic²

1. Background and Introduction:

The United Nations Agenda 2030 and the Kingdom of Saudi Arabia's Vision 2030 are co-dependent. The cornerstone and measuring stick for the viable fulfillment of Agenda 2030 are the Sustainable Development Goals (SDGs) (UN 2015). The 17 SDGs are associated with 169 targets and 232 indicators. An integral role that the economics literature has to contribute to Agenda 2030 and the SDGs is forecasting. There is a large body of literature related to empirical time-series forecasting. This paper's contribution is in implementing time-series and nearest-neighbor (NN) matching techniques developed by Abu-Ismaïl et al. (2015). The combination permits not just forecasting the Kingdom of Saudi Arabia's historical performance for each of the SDGs but also matching similar countries so that their performance can be compared to offer alternative and possibly superior policy strategies to achieve the 17 SDGs and Agenda 2030. The paper does not analyze the matched countries' policy strategies but interpolates their performance to project SDG performance for the Kingdom.

2. Data and Methodology:

In the **first step**, we download the data³ used for the Sustainable Development Report (SDR) (Sachs 2020). We extract the last worksheet, Raw Trend Data. The Raw Trend Data is a collection of all the indicators, except for SDG 12, for 193 countries from 2000 to 2020. Since the Raw Trend Data does not include SDG 12, the next step is to extract the seven SDG 12 indicators from the second worksheet, SDR2020 Data, within the original data file. For each of the SDG 12 indicators, there is one year of observation. Lastly, for this step, we merge the SDG 12 indicators with the other set of indicators and drop all observations before 2010.

In the **second step**, each indicator is normalized⁴. This step creates the most substantial deviation from the original work by the SDR. The SDR creates a snapshot of the status of each of the 17 SDG and an overall score. To create the snapshot, each indicator is normalized across the most recent observation year, not across the entire sample. So the normalization induces a comparison across the 193 countries for the most recent data point. However, for this paper's scope and the objectives in the application of this material, this paper normalizes each indicator across the entire dataset, from 2010 to 2020 and across all 193 countries. Careful attention must be used in this normalization step because some indicators use

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³ <https://sdsna.github.io/SDR2020/SDR2020Database.xlsx>

⁴ $Z_{i,j,t} = \left(\frac{x_{i,j,t} - \min(x_i)}{\max(x_i) - \min(x_i)} \right) * 100$; SDG i 's score for country j during time t

inverted scoring; the lower, the better. To remedy this issue, the indicators using inverted scoring need to be multiplied by a negative one for compatibility for a future step.

In the **third step**, to best match the essence of the SDR, generating a composite SDG score by using the most recent data, each indicator is carried-forward. Then next, the indicators are then carried-backward to prevent dynamic reweighting based on data gaps. This step marks a substantial trade-off between consistency with the score weightings and assuming no change occurred in situations of indicators being carried-backward. Removing observations before 2010 lessens the latter's magnitude by reducing the maximum number of potential years an indicator can be carried-backward.

In the **fourth step**, a simple arithmetic mean⁵ of all the indicators associated with each SDG by each country and year is calculated⁶. These means are called the SDG *i* score, *i* refers to a given SDG. Then another simple arithmetic mean of all 17 of the SDGs is calculated and named the overall SDG score.

In the **fifth step**, first, we replace each SDG score if it has a zero with 0.00001. This is necessary when calculating the growth rate, and the replaced value is an arbitrary value close to zero. The growth rate method used is the Compound Average Growth Rate (CAGR)⁷.

$$CAGR_{i,j} = \left(\frac{\bar{S}_{j,T}}{S_{i,j,t}} \right)^{1/[(T-t)+1]} - 1$$

$\bar{S}_{i,j,T}$: SDG *i*'s score for country *j* during time *T*

$S_{i,j,t}$: SDG *i*'s score for country *j* during time *t*

i: 1, ..., 17

j = 1, ..., 193

t ≡ 2010 & *T* ≡ 2020

Henceforth, if the term growth rate is used, it is only referring to a CAGR.

In the **sixth step**, we calculate the NN match score; first, the absolute value of each of the 17 SDGs for the Kingdom of Saudi Arabia (KSA) in 2020 is then subtracted from each other countries 17 SDG scores from 2010. The reason for taking the difference between the KSA's 2020 score and other country's 2010 score is to provide a better forecast when interpolating the matched country's growth rate on the KSA's forecasted 2030 SDR score. Then by each country, all 17 SDG calculations are then summed. Lastly, the sums are then sorted in ascending order; the lower the score, the closer a given country matches the KSA⁸. Below is the entire NN operation is written in summation notation:

⁵ Simple arithmetic mean: $S_{i,j,t} = \frac{1}{N_i} \sum_{n_i=1}^{N_i} I_{n,i,j,t}$; n_i : the number of indicators for SDG *i*

⁶ Ideally, it would be better to match countries using indicator scores; however, this is not possible for the entire sample, but possibly some subsamples, due to the variability of indicators reported between countries.

⁷ The notation is only for individual SDG CAGRs, not the overall SDG CAGR. To calculate the overall SDG CAGR the same equation is used; however, the subscripts will be simplified.

⁸ A detailed explanation of why it is superior to match based on all 17 SDGs compared to the overall SDG score can be found in the next section, 2.1 Nearest-Neighbor Matching Method Comparison.

$$\min \sum_{i=1}^{17} |SDG_{i,KSA} - SDG_{i,j}|$$

$i = 1, \dots, 17; i: SDG$

$j = 1, \dots, 192; j: country$

In the **seventh step**, the NN matches are then separated into groups. The highest-ranked fifteen percent of the 192 countries, 29 countries, from each SDG and overall SDG score are selected. Then all 15⁹ of the groups are sorted in descending order by their average annual growth rate. From each of the 15 groups, five countries with the highest average annual growth rates were then selected and called the Top 5 by SDG i or Overall SDG Score. Lastly, from each of the 15 groups, five countries with the lowest annual growth rates are selected and called the Bottom 5 by SDG i or Overall SDG Score.

In the **eighth and final step**, Top and Bottom 5 groups' annual growth rates from each of the 15 collections of 29 countries are averaged. Next, using the 2020 SDR scores for each SDG and the overall score as a starting point, the SDG scores for KSA are extrapolated to 2030 using the mean annual Top 5 and Bottom 5 NN growth rates, as well as the historical KSA annual growth rate.

2.1. Nearest-Neighbor Matching Method Comparison:

The NN matching method implemented provides different results than if the NN match was performed by calculating the absolute value of the overall score for the KSA in 2020, which is then subtracted from each other countries' overall SDG score. When taking the absolute value of the overall scores' difference, the method is simply matching based on overall ranking relative to the KSA, not necessarily how well a country matches the KSA because the overall score is a composite score (simple arithmetic mean) of all 17 SDG scores. A country could have a similar overall score but grossly different SDG sub-scores.

As a simple illustration, assume country A has a score of 50 out of 100 for all odd-numbered SDGs, except for SDG 17, with a score of zero out of 100. Country B has a score of 50 out of 100 for all even-numbered SDGs, except for SDG 17, with a score of zero out of 100. Lastly, country C has a score of 100 out of 100 for the first four even numbered SDGs, and the remaining with scores of zero out of 100. Table 1 in the appendix list the example of the three countries. All three countries have the same overall SDG score (simple arithmetic mean) of 23.5; however, if you assume country A is the baseline country, then using the method implemented in the NN analysis, country C would best match country A. It is trivial to see in the illustration that countries A and B are least alike because they alternate values, but they would be matched perfectly using the alternative matching method. This is problematic when trying to match most similar countries. Therefore, the superior matching method is the one implemented in the NN analysis. A side-by-side comparison is in the appendix for reference (Table 2). Comparing the matching results based on the two mentioned methods. The method is noted in summation notation below for reference:

⁹ There should theoretically be 18 groups; however, SDGs 1 and 10 do not have data for the KSA, and SDG 12 only has one year of data.

Method Implemented in Nearest-Neighbor Analysis:

$$\min \sum_{i=1}^{17} |SDG_{i,KSA} - SDG_{i,j}|$$

Alternative Method Not Implemented in Nearest-Neighbor Analysis:

$$\min \left| \frac{1}{17} \sum_{i=1}^{17} SDG_{i,KSA} - \frac{1}{17} \sum_{i=1}^{17} SDG_{i,j} \right|$$

$i = 1, \dots, 17; i: SDG$

$j = 1, \dots, 192; j: country$

3. Conclusion & Nearest Neighbors Results:

Matching each of the KSA’s 2020 SDGs and overall SDG scores to other countries’ 2010 SDG scores allows for a better projection of the annual growth rate the KSA can potentially expect to observe going forward, depending on the policy mix the country chooses in the next ten years. The KSA’s annual growth rate from 2010 to 2020 of 0.38% is in the 50th percentile of annual growth rates for the entire sample of countries. A 0.38% annual growth rate could be sustained for the next ten years. Conversely, for countries in the Top 5, the average annual growth rate is 0.67%, and for countries in the Bottom 5, the average annual growth rate is -0.02. These three annual growth rate averages give a realistic projection over the next ten years for the KSA if similar improvement strategies are implemented. If the KSA were able to choose the policy mix to sustain the Top 5 NN average annual growth rate of 0.67% for the next ten years, the KSA’s projected 2030 score would rank in the top 70 globally in the SDR based on the current rankings, an improvement of 28 places in the 2020 ranking.

3.1. Nearest Neighbors Results: Top 5, Bottom 5, & KSA’s Average Annual CAGR and Forecasts by SDG

The table below lists the Top 5, Bottom 5, and KSA’s average annual growth rate. The first column refers to the SDG group or “All,” which refers to the overall SDG score’s annual growth rate. “NA” represents either there is no data, the case for SDGs 1 and 10, or for there is only one year of data, the case for SDG 12. Therefore, the annual growth rates cannot be calculated for SDG 1, 10, and 12.

SDG:	Top 5 Average CAGR:	Bottom 5 Average CAGR:	KSA’s CAGR:
All	0.67%	-0.02%	0.38%
SDG 1	NA	NA	NA
SDG 2	0.34%	-0.15%	0.62%
SDG 3	0.32%	-0.16%	0.22%
SDG 4	0.27%	-0.94%	0.09%
SDG 5	2.18%	-1.27%	2.50%
SDG 6	0.25%	-0.06%	0.05%
SDG 7	0.11%	-0.02%	0.01%

SDG 8	1.62%	-0.36%	1.49%
SDG 9	2.96%	0.36%	2.58%
SDG 10	NA	NA	NA
SDG 11	1.82%	-0.86%	0.27%
SDG 12	NA	NA	NA
SDG 13	0.31%	-0.42%	0.01%
SDG 14	1.08%	-1.32%	-0.24%
SDG 15	2.75%	-0.59%	-0.27%
SDG 16	0.68%	-0.91%	0.18%
SDG 17	1.77%	-1.58%	0.00%

The table below lists the Top 5, Bottom 5, and KSA's forecasts for 2030. The first column refers to the SDG group or "All," which refers to the overall SDG score's annual growth rate. "NA" represents either there is no data, the case for SDGs 1 and 10, or for there is only one year of data, the case for SDG 12. Therefore, the forecasts cannot be calculated for SDG 1, 10, and 12.

SDG:	2020 KSA Score:	Top 5 CAGR 2030 Forecast:	Bottom 5 CAGR 2030 Forecast:	Historical KSA CAGR 2030 Forecast:
All	65.8	70.4	65.7	68.3
SDG 1	NA	NA	NA	NA
SDG 2	67.9	70.3	66.9	72.3
SDG 3	85.5	88.2	84.1	87.4
SDG 4	83.4	85.8	75.9	84.2
SDG 5	39.0	48.3	34.3	49.9
SDG 6	94.3	96.7	93.7	94.8
SDG 7	98.1	99.2	97.8	98.1
SDG 8	54.1	63.5	52.2	62.7
SDG 9	45.2	60.4	46.8	58.3
SDG 10	NA	NA	NA	NA
SDG 11	43.9	52.5	40.2	45.0
SDG 12	NA	NA	NA	NA
SDG 13	85.3	88.0	81.8	85.4
SDG 14	60.6	67.5	53.1	59.2
SDG 15	42.1	55.1	39.6	40.9
SDG 16	69.3	74.2	63.2	70.6
SDG 17	25.7	30.7	22.0	25.7

3.2. Nearest Neighbors Results: Top 5 & Bottom 5 Economies by SDG

The fifteen tables below list the Top 5 and Bottom 5 economies in the 15% (29 countries) NN matches by SDG group. The average value is the number used when interpolating the KSA's year-over-year forecast from 2021 to 2030.

Top 5 Economies: Overall SDG Score	Annual Growth Rate:	Bottom 5 Economies: Overall SDG Score	Annual Growth Rate:
United Arab Emirates	1.20%	Lebanon	0.05%
Morocco	0.65%	Qatar	0.03%
Maldives	0.55%	Kuwait	0.02%
Croatia	0.51%	Jordan	-0.07%
Kazakhstan	0.44%	Libya	-0.12%
Average:	0.67%	Average:	-0.02%

Top 5 Performers: SDG 2	Annual Growth Rate:	Bottom 5 Performers: SDG 2	Annual Growth Rate:
St. Vincent and the Grenadines	0.65%	Montenegro	-0.26%
Vietnam	0.56%	Bosnia and Herzegovina	-0.15%
Ukraine	0.22%	Bahrain	-0.13%
Kazakhstan	0.17%	Samoa	-0.10%
Suriname	0.12%	Tunisia	-0.09%
Average:	0.34%	Average:	-0.15%

Top 5 Performers: SDG 3	Annual Growth Rate:	Bottom 5 Performers: SDG 3	Annual Growth Rate:
Maldives	0.41%	Marshall Islands	-0.32%
Portugal	0.41%	St. Lucia	-0.26%
Spain	0.29%	Panama	-0.11%
Oman	0.27%	Montenegro	-0.11%
Greece	0.23%	Grenada	-0.02%
Average:	0.32%	Average:	-0.16%

Top 5 Performers: SDG 4	Annual Growth Rate:	Bottom 5 Performers: SDG 4	Annual Growth Rate:
Maldives	0.37%	Marshall Islands	-1.68%
Sri Lanka	0.28%	St. Vincent and the Grenadines	-0.97%
Estonia	0.27%	Ukraine	-0.80%
Canada	0.25%	Qatar	-0.74%
Fiji	0.20%	Oman	-0.54%
Average:	0.27%	Average:	-0.94%

Top 5 Performers: SDG 5	Annual Growth Rate:	Bottom 5 Performers: SDG 5	Annual Growth Rate:
Djibouti	2.66%	Liechtenstein	-6.11%
Algeria	2.47%	Seychelles	-0.93%
Monaco	2.25%	Syrian Arab Republic	0.15%
Liberia	1.94%	Maldives	0.27%

Libya	1.58%	Nigeria	0.29%
Average:	2.18%	Average:	-1.27%

Top 5 Performers: SDG 6	Annual Growth Rate:	Bottom 5 Performers: SDG 6	Annual Growth Rate:
Maldives	0.38%	Serbia	-0.17%
Turkmenistan	0.26%	Estonia	-0.08%
Czech Republic	0.22%	Grenada	-0.05%
Israel	0.20%	Bulgaria	-0.02%
Albania	0.20%	St. Kitts and Nevis	0.00%
Average:	0.25%	Average:	-0.06%

Top 5 Performers: SDG 7	Annual Growth Rate:	Bottom 5 Performers: SDG 7	Annual Growth Rate:
Iraq	0.15%	Syrian Arab Republic	-0.09%
Azerbaijan	0.13%	Mauritius	-0.03%
Brazil	0.10%	Lebanon	0.00%
Armenia	0.09%	Cyprus	0.00%
Antigua and Barbuda	0.09%	Kuwait	0.00%
Average:	0.11%	Average:	-0.02%

Top 5 Performers: SDG 8	Annual Growth Rate:	Bottom 5 Performers: SDG 8	Annual Growth Rate:
Estonia	2.05%	St. Lucia	-1.77%
Ireland	1.86%	Papua New Guinea	-0.12%
Iceland	1.47%	San Marino	0.00%
United Arab Emirates	1.41%	Cyprus	0.04%
Czech Republic	1.32%	Comoros	0.05%
Average:	1.62%	Average:	-0.36%

Top 5 Performers: SDG 9	Annual Growth Rate:	Bottom 5 Performers: SDG 9	Annual Growth Rate:
United Arab Emirates	3.70%	Canada	-0.09%
Qatar	3.00%	Australia	0.37%
Cyprus	2.89%	Ireland	0.42%
Czech Republic	2.60%	United Kingdom	0.43%
China	2.58%	France	0.66%
Average:	2.96%	Average:	0.36%

Top 5 Performers: SDG 11	Annual Growth Rate:	Bottom 5 Performers: SDG 11	Annual Growth Rate:
Myanmar	2.26%	Nigeria	-1.76%

Mali	1.84%	Central African Republic	-0.93%
Bangladesh	1.71%	Liberia	-0.61%
Tanzania	1.65%	Cameroon	-0.55%
Afghanistan	1.62%	Sierra Leone	-0.47%
Average:	1.82%	Average:	-0.86%

Top 5 Performers: SDG 13	Annual Growth Rate:	Bottom 5 Performers: SDG 13	Annual Growth Rate:
Bahrain	0.62%	Palau	-0.69%
Finland	0.26%	United Arab Emirates	-0.50%
Norway	0.25%	Brunei Darussalam	-0.38%
Denmark	0.24%	San Marino	-0.30%
Australia	0.20%	Turkmenistan	-0.22%
Average:	0.31%	Average:	-0.42%

Top 5 Performers: SDG 14	Annual Growth Rate:	Bottom 5 Performers: SDG 14	Annual Growth Rate:
Mozambique	1.60%	Jordan	-2.98%
Honduras	1.51%	Papua New Guinea	-1.83%
Sudan	1.29%	Gabon	-0.67%
Oman	0.58%	Venezuela, RB	-0.59%
Egypt, Arab Rep.	0.42%	Fiji	-0.54%
Average:	1.08%	Average:	-1.32%

Top 5 Performers: SDG 15	Annual Growth Rate:	Bottom 5 Performers: SDG 15	Annual Growth Rate:
Croatia	5.77%	Comoros	-0.75%
Morocco	4.58%	Maldives	-0.72%
Cameroon	2.28%	Papua New Guinea	-0.55%
Vietnam	0.86%	Philippines	-0.50%
South Africa	0.24%	Montenegro	-0.43%
Average:	2.75%	Average:	-0.59%

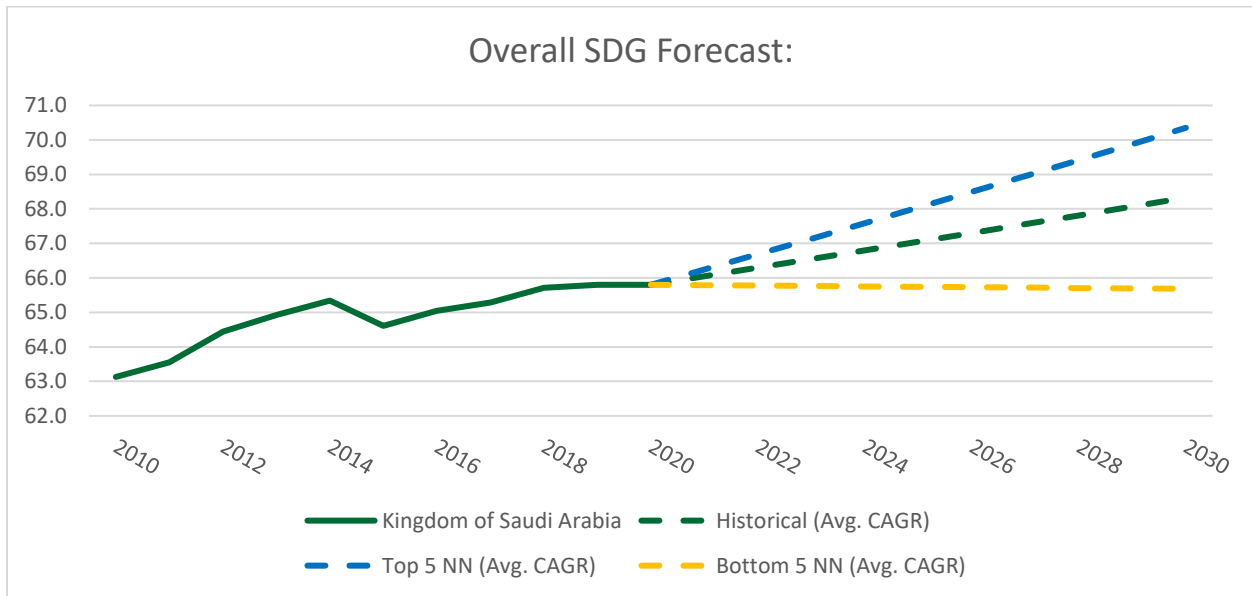
Top 5 Performers: SDG 16	Annual Growth Rate:	Bottom 5 Performers: SDG 16	Annual Growth Rate:
Lithuania	1.08%	Bahrain	-1.09%
Latvia	0.82%	Turkey	-1.03%
Greece	0.61%	Mali	-1.00%
Bhutan	0.49%	Mauritania	-0.74%
Moldova	0.39%	Zambia	-0.71%
Average:	0.68%	Average:	-0.91%

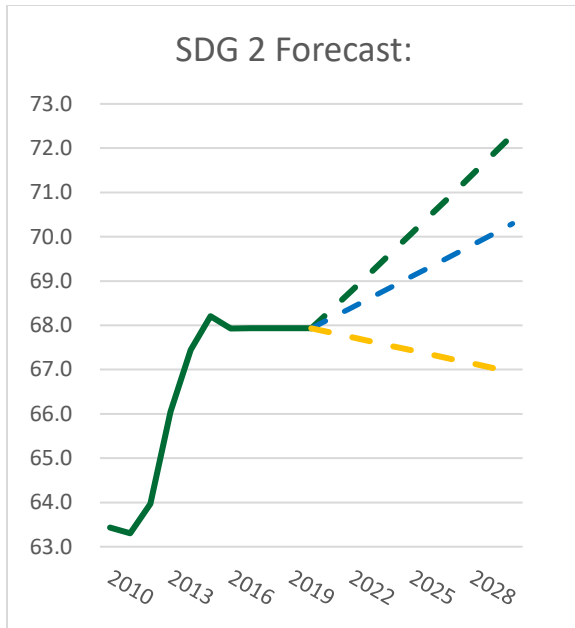
Top 5 Performers: SDG 17	Annual Growth Rate:	Bottom 5 Performers: SDG 17	Annual Growth Rate:
Maldives	3.04%	Cyprus	-2.29%

Seychelles	2.26%	Greece	-1.77%
Andorra	1.46%	Azerbaijan	-1.59%
Italy	1.10%	Romania	-1.20%
San Marino	1.02%	Vietnam	-1.04%
Average:	1.77%	Average:	-1.58%

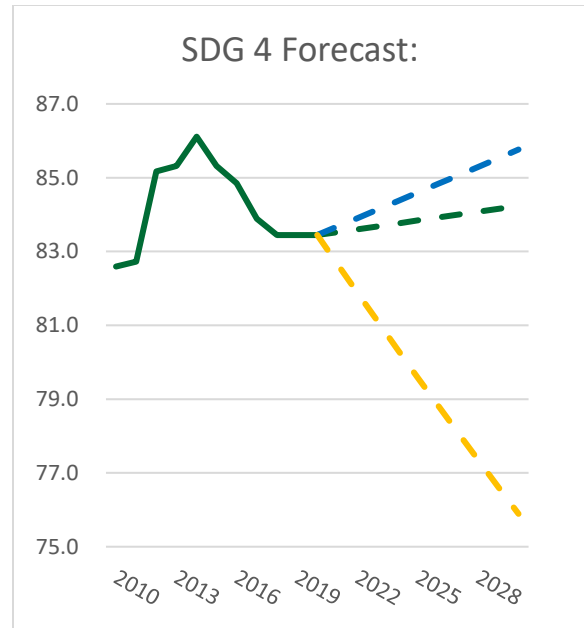
3.3. Nearest Neighbors Results: Graphical Forecast by SDG

The figures below display the KSA's historical and forecasted overall SDG score and for each SDG up to 2030. The green lines represent the KSA's historical scores, the yellow lines represent the Bottom 5 NN annual growth rate extrapolated for the KSA's future growth rate, the blue lines represent the KSA's continuation of its' 10-year historical annual growth rate, and the red lines represent the Top 5 NN annual growth rate extrapolated for the KSA's future annual growth rate.

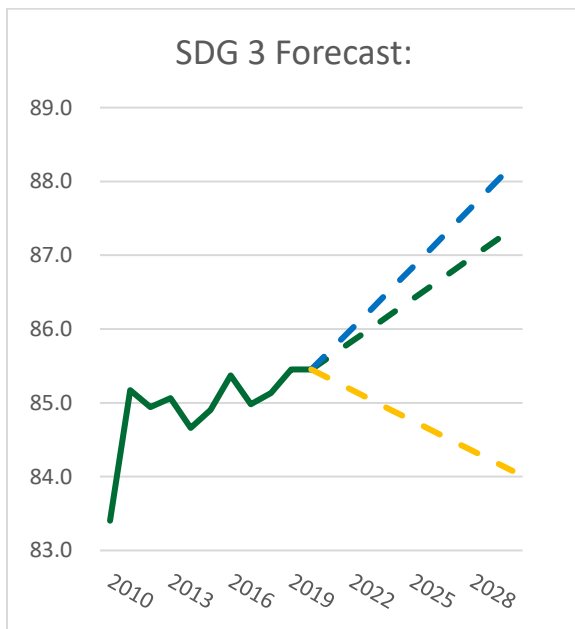




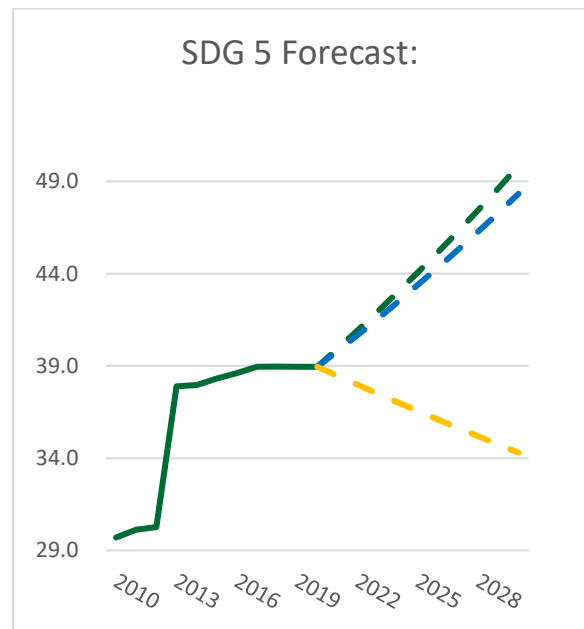
Under the Top 5 NN annual growth rate scenario for SDG 2, the KSA would have a score in 2030 of 70.3, which would rank it at 45th place in the 2020 ranking, an improvement of 21 places compared to the current 2020 ranking 66th.



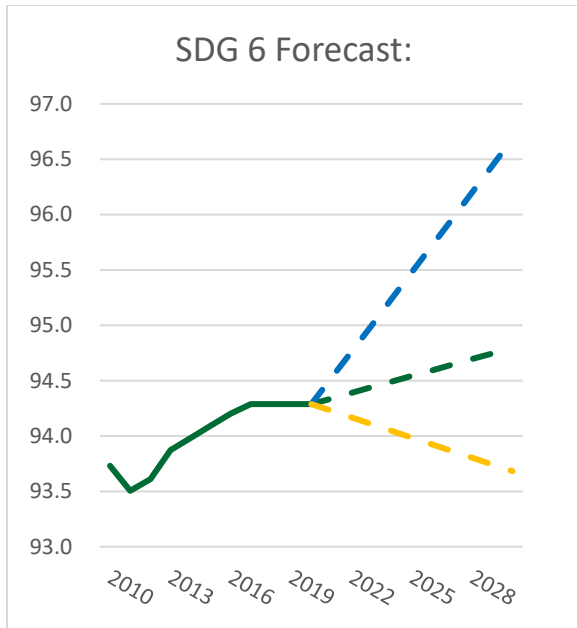
Under the Top 5 NN annual growth rate scenario for SDG 4, the KSA would have a score in 2030 of 85.8, which would rank it at 3rd place in the 2020 ranking, an improvement of 10 places compared to the current 2020 ranking 13th.



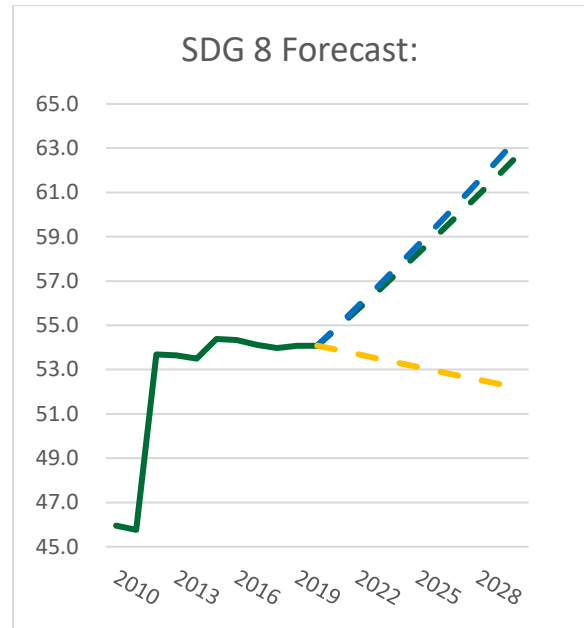
Under the Top 5 NN annual growth rate scenario for SDG 3, the KSA would have a score in 2030 of 88.2, which would rank it at 43rd place in the 2020 ranking, an improvement of 17 places compared to the current 2020 ranking 60th.



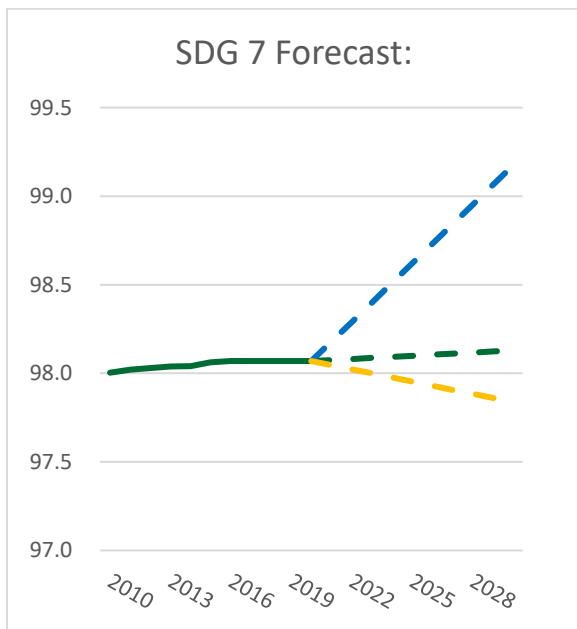
Under the Top 5 NN annual growth rate scenario for SDG 5, the KSA would have a score in 2030 of 48.3, which would rank it at 138th place in the 2020 ranking, an improvement of 37 places compared to the current 2020 ranking 175th.



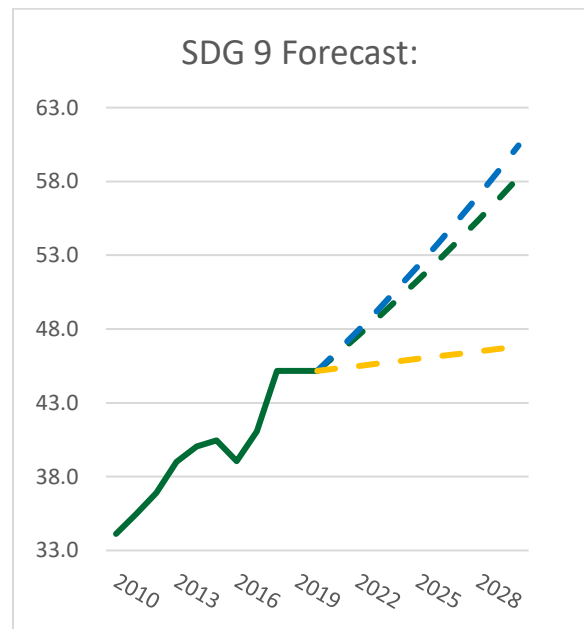
Under the Top 5 NN annual growth rate scenario for SDG 6, the KSA would have a score in 2030 of 96.7, which would rank it at 27th place in the 2020 ranking, an improvement of 34 places compared to the current 2020 ranking 61st.



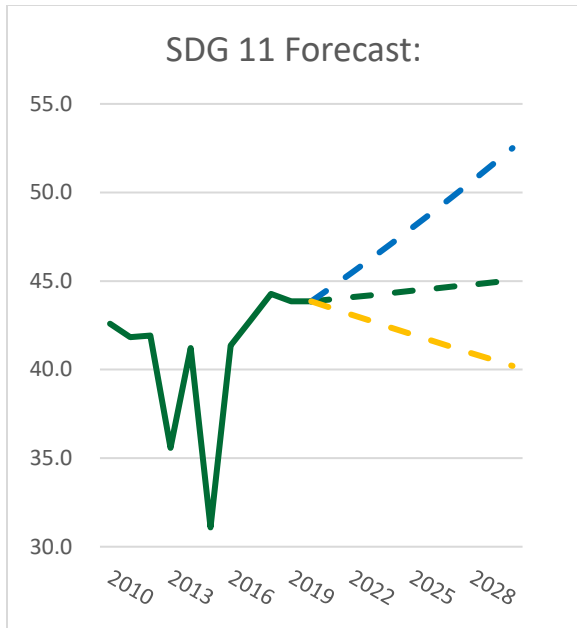
Under the Top 5 NN annual growth rate scenario for SDG 8, the KSA would have a score in 2030 of 63.5, which would rank it at 26th place in the 2020 ranking, an improvement of 32 places compared to the current 2020 ranking 58th.



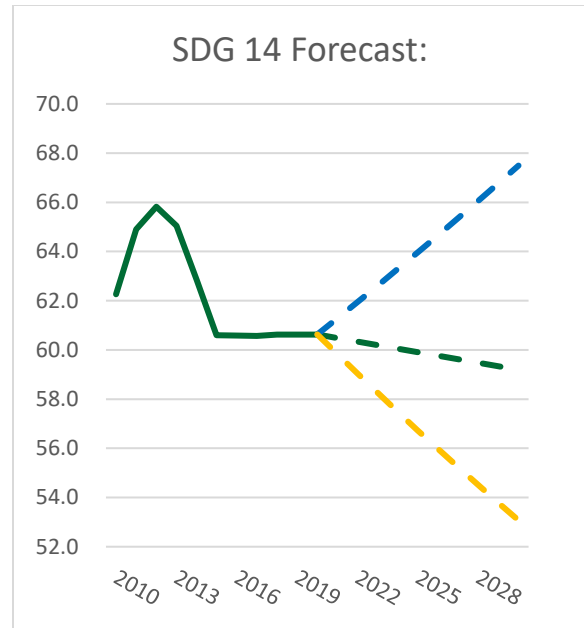
Under the Top 5 NN annual growth rate scenario for SDG 7, the KSA would have a score in 2030 of 99.2, which would rank it at 19th place in the 2020 ranking, an improvement of 18 places compared to the current 2020 ranking 37th.



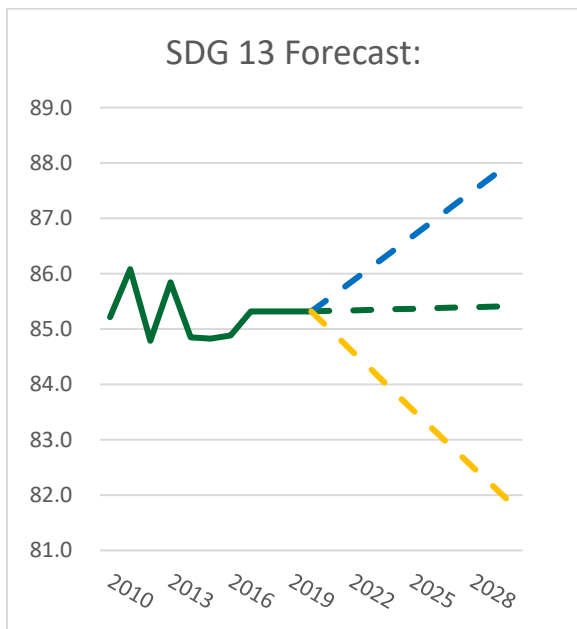
Under the Top 5 NN annual growth rate scenario for SDG 9, the KSA would have a score in 2030 of 60.4, which would rank it at 15th place in the 2020 ranking, an improvement of 19 places compared to the current 2020 ranking 34th.



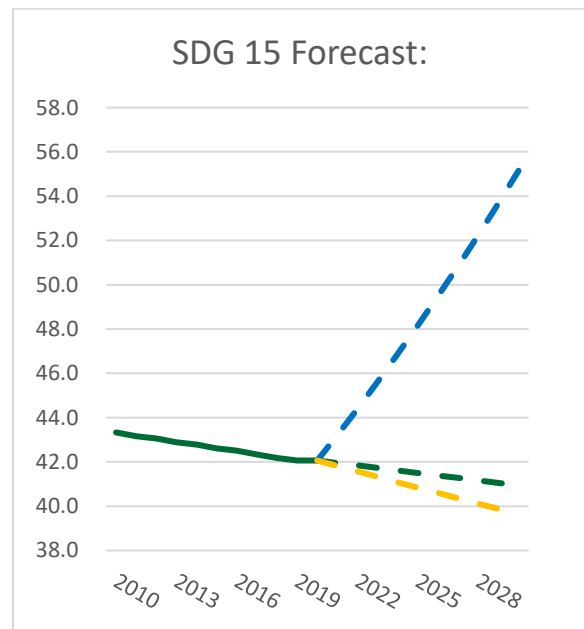
Under the Top 5 NN annual growth rate scenario for SDG 11, the KSA would have a score in 2030 of 52.5, which would rank it at 163rd place in the 2020 ranking, an improvement of 17 places compared to the current 2020 ranking 180th.



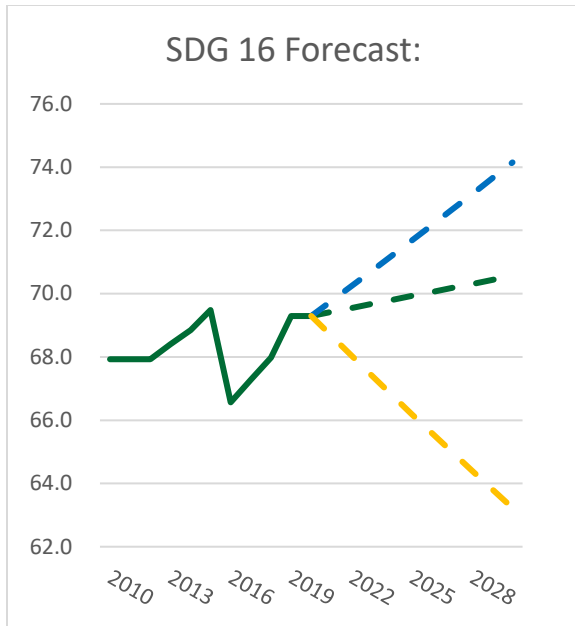
Under the Top 5 NN annual growth rate scenario for SDG 14, the KSA would have a score in 2030 of 67.5, which would rank it at 34th place in the 2020 ranking, an improvement of 22 places compared to the current 2020 ranking 56th.



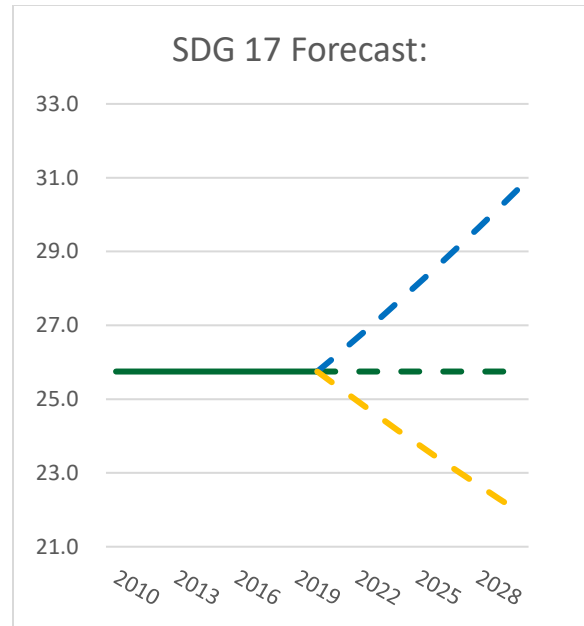
Under the Top 5 NN annual growth rate scenario for SDG 13, the KSA would have a score in 2030 of 88.0, which would rank it at 178th place in the 2020 ranking, an improvement of 5 places compared to the current 2020 ranking 183rd.



Under the Top 5 NN annual growth rate scenario for SDG 15, the KSA would have a score in 2030 of 55.1, which would rank it at 93rd place in the 2020 ranking, an improvement of 53 places compared to the current 2020 ranking 146th.



Under the Top 5 NN annual growth rate scenario for SDG 16, the KSA would have a score in 2030 of 74.2, which would rank it at 68th place in the 2020 ranking, an improvement of 20 places compared to the current 2020 ranking 89th.



Under the Top 5 NN annual growth rate scenario for SDG 17, the KSA would have a score in 2030 of 30.7, which would rank it at 46th place in the 2020 ranking, an improvement of 31 places compared to the current 2020 ranking 77th.

3.4. Nearest Neighbors Results: Outliers for the KSA's Forecast

There are several SDG forecasts worth mentioning. Notably, the figures representing SDGs 2, 3, 4, 5, 8, and 9. In the case of SDG 2 and 5, both of which the blue line, representing the KSA's continuation of its' 10-year historical annual growth rate, outgrows that of the red line or the interpolated Top 5 NN annual growth rate. For SDG 2, the exceptional annual growth rate is almost entirely driven by the Sustainable Nitrogen Management Index indicator's growth. As for SDG 5, the exceptional annual growth rate is entirely driven by the growth in the percent of seats held by women in parliament indicator (prior to 2013, the percent was zero). For SDGs 3, 4, 8, and 9, all of which the blue line, representing the KSA's continuation of its' 10-year historical annual growth rate, almost outgrows that of the red line or the interpolated Top 5 NN annual growth rate. For SDGs 3 and 4, no one indicator causes this high annual growth rate, but overall, the indicators grew exceptionally fast. As for SDG 8, the high annual growth rate is almost entirely driven by the percent of adults with an account at a bank or other financial institution or with a mobile-money-service provider indicator. As for SDG 9, the high annual growth rate is almost entirely driven by both the percent of the population using the internet and the per capita published scientific and technical journal articles indicators. It is unlikely the KSA can sustain its' historical annual growth rate for both SDG 2 and 5, which is above the interpolated Top 5 NN annual growth rate, primarily since each of the KSA's historical annual growth rates are driven almost entirely by one indicator for each SDG. Conversely, it is reasonable for the KSA to sustain its' historical annual growth rate for both SDG 3 and 4 due to the higher annual growth rates not being driven by a single indicator. Lastly, it is unlikely that the KSA can sustain its' historical annual growth rate for both SDG 8 and 9 due to the higher annual growth rates being almost entirely driven by either one or two indicators.

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Appendix:

Table 1:

Country A (Baseline)			Country B			Country C		
SDG	Score	Method 2	SDG	Score	Method 2	SDG	Score	Method 2
1	50	-	1	0	50	1	100	50
2	0	-	2	50	50	2	0	0
3	50	-	3	0	50	3	100	50
4	0	-	4	50	50	4	0	0
5	50	-	5	0	50	5	100	50
6	0	-	6	50	50	6	0	0
7	50	-	7	0	50	7	100	50
8	0	-	8	50	50	8	0	0
9	50	-	9	0	50	9	0	50
10	0	-	10	50	50	10	0	0
11	50	-	11	0	50	11	0	50
12	0	-	12	50	50	12	0	0
13	50	-	13	0	50	13	0	50
14	0	-	14	50	50	14	0	0
15	50	-	15	0	50	15	0	50
16	0	-	16	50	50	16	0	0
17	0	-	17	0	0	17	0	0
<u>23.5</u> -			<u>23.5</u> 800			<u>23.5</u> 400		

Table 2:

Economy	Overall SDG Score 2010	Overall SDG Score 2020	Nearest- Neighbor Match Ranking				
				Bulgaria	70.8	72.9	66
Denmark	79.6	80.9	147	Andorra	70.3	71.7	102
Norway	79.2	79.7	131	Costa Rica	70.1	71.9	53
Finland	78.9	79.4	111	Hungary	69.7	70.8	115
Netherlands	78.0	78.5	137	Slovak Republic	69.7	71.9	99
Sweden	77.5	79.8	127	Thailand	69.5	71.0	30
Switzerland	75.6	78.1	100	Portugal	69.4	71.6	76
Germany	75.2	76.6	119	Spain	69.3	71.0	64
Austria	75.1	77.1	80	Uruguay	69.2	71.3	56
France	75.0	76.2	110	Latvia	69.0	70.0	98
Ireland	74.0	75.4	118	Romania	68.9	71.8	44
Iceland	73.9	74.7	78	Malaysia	68.9	70.5	5
United Kingdom	73.7	75.6	85	Argentina	68.8	70.2	37
Belgium	73.6	75.2	124	Barbados	68.8	69.3	40
Singapore	73.5	73.6	109	Australia	68.8	70.6	60
Luxembourg	73.0	73.6	122	San Marino	68.7	72.1	6
Czech Republic	73.0	75.6	90	Brazil	68.7	69.7	24
Malta	72.8	75.9	49	Poland	68.6	71.9	108
Cyprus	72.1	74.2	22	Serbia	68.5	70.7	14
Japan	72.0	73.1	45	Italy	67.9	69.8	89
New Zealand	72.0	73.0	72	Tonga	67.8	68.4	123
Canada	71.9	72.4	34	Cuba	67.8	69.3	93
Croatia	71.5	75.7	8	Brunei Darussalam	67.8	69.4	38
Estonia	71.4	73.8	83	United States	67.5	68.7	25
Slovenia	71.1	73.6	112	United Arab Emirates	67.3	76.8	12
Liechtenstein	71.0	66.9	55	St. Lucia	67.0	67.5	65
Belarus	70.9	73.9	23	Ecuador	66.9	71.1	61
				Dominican Republic	66.9	69.8	103

Greece	66.8	68.3	77	Oman	64.2	66.5	2
Korea, Rep.	66.6	68.6	19	Paraguay	64.1	68.0	88
Montenegro	66.6	69.3	31	St. Vincent and the Grenadines	64.1	65.0	46
Venezuela, RB	66.4	62.0	84	Guyana	64.1	69.1	141
Lithuania	66.3	69.4	106	Jordan	64.0	63.5	16
Trinidad and Tobago	66.3	66.7	27	Nicaragua	63.9	66.7	128
Moldova	66.2	68.5	48	Uzbekistan	63.9	68.4	41
Iran, Islamic Rep.	66.1	69.0	13	Fiji	63.9	66.5	101
Palau	65.9	67.1	149	Maldives	63.6	67.6	11
Kazakhstan	65.7	69.0	20	Suriname	63.6	65.8	94
Russian Federation	65.7	68.4	32	Georgia	63.5	68.1	58
Samoa	65.7	67.0	92	Bosnia and Herzegovina	63.1	64.8	57
Ukraine	65.6	67.1	28	China	63.0	67.2	52
Tunisia	65.6	67.6	17	Egypt, Arab Rep.	62.9	65.7	9
Kuwait	65.4	65.5	26	Bolivia	62.9	66.7	79
Jamaica	65.3	65.5	63	Bahamas, The	62.8	64.8	70
Azerbaijan	65.2	68.4	21	Grenada	62.8	68.5	59
North Macedonia	65.2	70.0	39	Lebanon	62.8	63.1	10
Panama	65.1	68.3	42	Vietnam	62.7	67.5	54
Colombia	65.1	68.5	50	El Salvador	62.6	65.8	104
Peru	65.0	67.7	62	Antigua and Barbuda	62.5	63.1	74
Bahrain	64.7	66.0	1	Qatar	62.4	62.6	3
Kyrgyz Republic	64.5	68.5	69	Morocco	62.4	67.0	15
Mauritius	64.5	66.3	51	Israel	62.4	65.5	68
Tuvalu	64.5	64.9	166	Monaco	62.3	63.8	129
Albania	64.4	67.8	75	Mongolia	62.2	64.8	36
Armenia	64.4	67.2	18	Belize	62.1	63.5	35
Algeria	64.3	66.2	29	Botswana	61.4	65.0	133

Sri Lanka	61.4	64.9	43	Vanuatu	55.1	57.0	146
South Africa	61.4	63.8	87	Nepal	54.5	61.2	107
Saudi Arabia	61.3	63.9	NA	Mexico	54.3	56.7	140
St. Kitts and Nevis	61.3	63.9	7	Timor-Leste	54.1	59.9	173
Tajikistan	61.2	65.3	67	Kenya	53.7	58.6	130
Cabo Verde	61.0	63.8	114	Congo, Rep.	53.7	54.0	165
Seychelles	60.6	62.3	47	Equatorial Guinea	53.3	54.1	180
Bhutan	60.4	65.5	105	Myanmar	53.3	59.0	120
Honduras	60.2	63.5	117	Bangladesh	53.2	58.2	95
Chile	60.1	64.1	91	Cambodia	53.1	59.6	148
Philippines	60.1	62.4	71	India	53.1	58.6	81
Namibia	60.1	65.1	163	Cote d'Ivoire	52.6	58.1	157
Kiribati	59.7	63.9	177	Nauru	52.5	56.5	126
Libya	59.5	58.7	4	Senegal	52.4	57.6	138
Gabon	59.3	61.8	97	Lao PDR	52.1	58.4	144
Dominica	58.9	62.7	86	Gambia, The	51.8	54.5	161
Korea, Dem. Rep.	58.8	60.2	134	Eswatini	51.8	55.1	153
Ghana	58.5	62.4	132	Rwanda	51.0	55.3	160
Marshall Islands	58.2	59.2	125	Comoros	50.9	52.3	139
Indonesia	57.6	63.0	82	Micronesia, Fed. Sts.	50.7	53.8	188
Sao Tome and Principe	57.0	61.1	150	Pakistan	50.7	54.6	135
Guatemala	56.9	60.5	116	Cameroon	50.5	54.6	121
Zimbabwe	56.6	58.4	143	Zambia	50.4	52.4	156
Turkey	56.4	57.5	113	Yemen, Rep.	50.0	50.6	136
Turkmenistan	56.2	61.2	33	Mauritania	49.9	53.9	152
Syrian Arab Republic	55.8	52.2	73	Tanzania	49.9	54.0	159
Iraq	55.7	58.2	96	Lesotho	49.8	53.7	181
Solomon Islands	55.3	57.3	175	Angola	49.7	51.6	145

Benin	49.3	52.8	154	Burkina Faso	45.0	51.1	184
Togo	49.2	53.0	164	Eritrea	44.9	45.7	176
Nigeria	49.2	49.2	151	Ethiopia	44.7	50.6	162
Mozambique	49.1	53.8	155	Haiti	44.4	46.7	142
Papua New Guinea	48.3	49.6	168	Mali	44.2	48.0	167
Guinea-Bissau	48.2	50.3	192	Niger	42.0	45.4	169
Sudan	48.1	49.9	158	Liberia	41.6	44.9	179
Djibouti	47.8	50.9	171	Afghanistan	40.4	45.6	172
Malawi	47.7	50.4	170	South Sudan	40.3	39.2	189
Burundi	47.6	48.4	183	Central African Republic	40.3	39.7	190
Guinea	47.6	51.5	187	Chad	39.9	42.8	191
Uganda	46.7	49.6	174	Congo, Dem. Rep.	39.7	42.9	186
Sierra Leone	46.0	49.7	182	Somalia	37.6	41.6	185
Madagascar	45.6	46.8	178				