

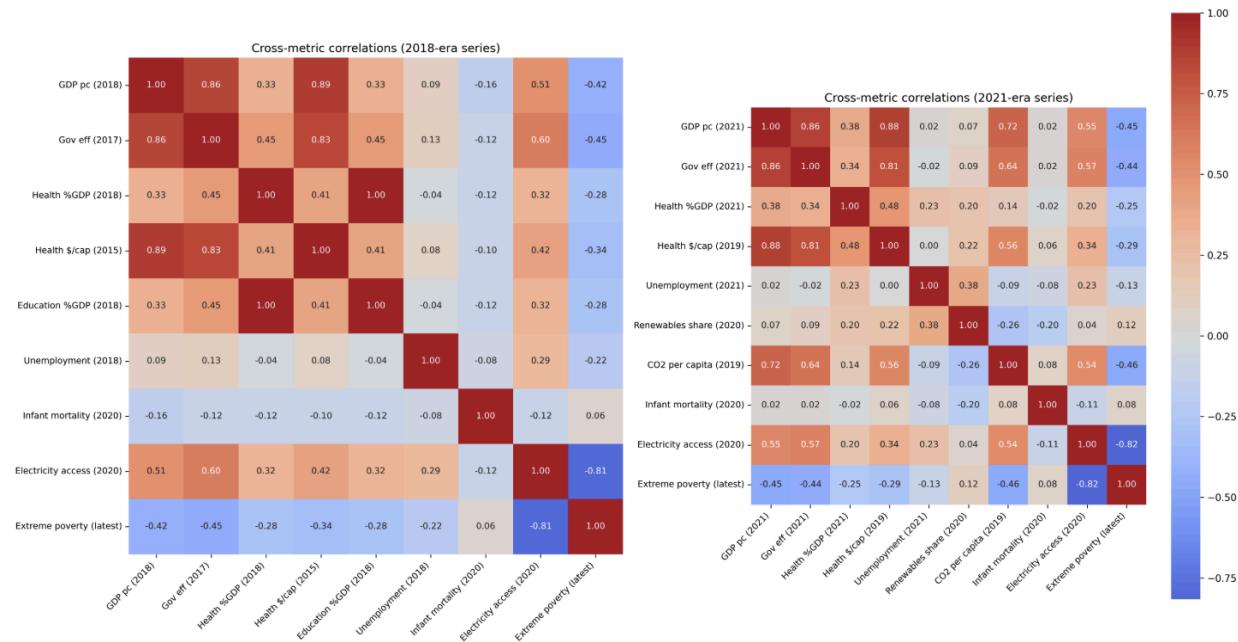
## Team Members:

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**Question 1: There are so many metrics, can I get a higher-level understanding of how these metrics are related to one another? In this question, your visualization should include multiple countries. Ideally, you should also include multiple years.**

## Visualization 1:

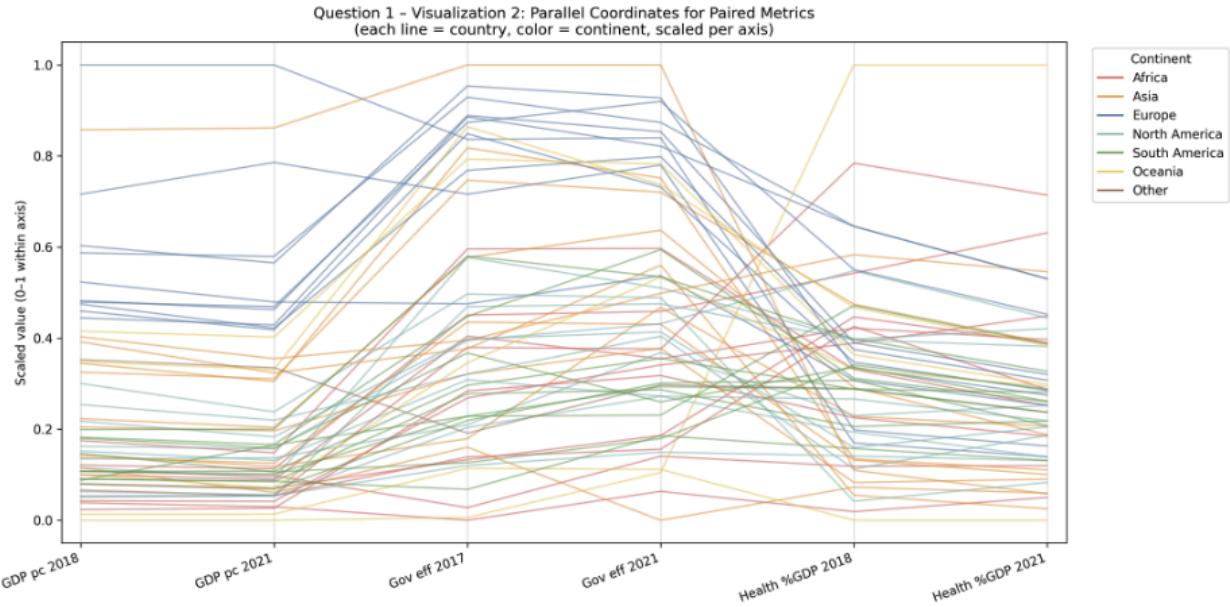
Question 1 – Visualization 1: Dual Correlation Heatmaps



## Explanation (Explain what the design encodes):

I computed Pearson correlation on the cleaned dataset for two year slices: 2018 era indicators and 2021 era indicators. The scaled heatmaps keep each axis label readable while the coefficients encode strength and direction as blue = positive, red = negative and then numbers shown. Findings key point 2021 include GDP per capita vs government effectiveness at  $r = 0.86$ , electricity access vs extreme poverty at  $r = -0.82$  and renewable share vs. CO<sub>2</sub> per capita at  $r = -0.26$ . Putting the two panels together shows that governance/wealth correlations remained strong, poverty/power tightened, and climate correlations changed modestly, all without examining the raw tables.

## Visualization 2:

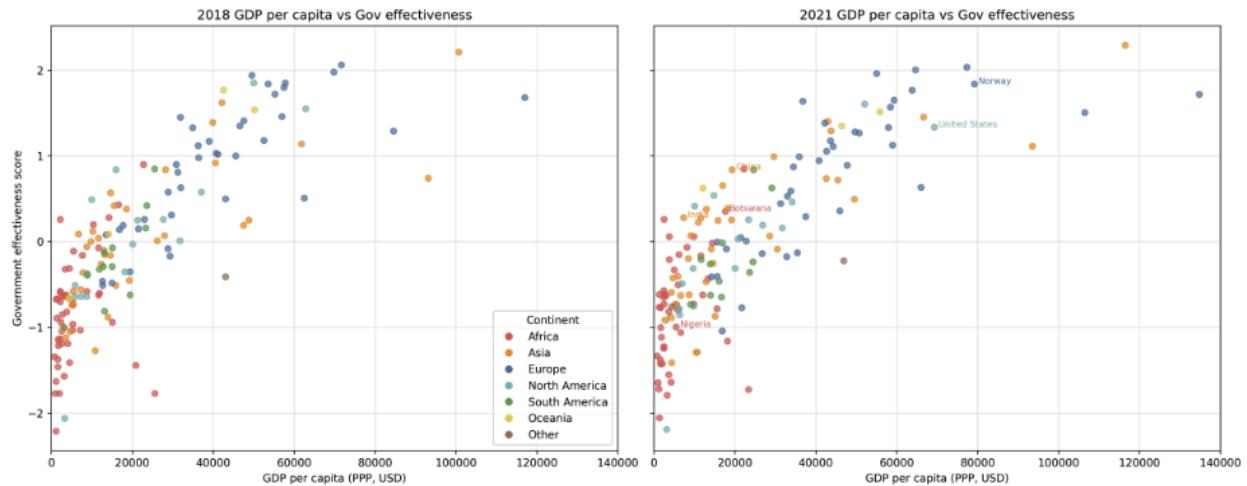


## Explanation (Explain what the design encodes):

This parallel plot employs 56 nations (up to 10 from each continent) and three paired axes: GDP per capita 2018 <-> 2021, government effectiveness 2017 <-> 2021, and health spending % of GDP 2018 <-> 2021. Every line (colored by continent) traverses the six scaled axes, allowing readers to compare the 2018 and 2021 positions on the same chart. The emphasized United States line indicates GDP increasing from \$62.8k to \$69.3k PPP, while governance decreases from 1.55 to 1.34; China's line improves on both measures, and various African lines rank low in GDP yet high in health % of GDP (for instance, Botswana 6.7% -> 8.7%). Since all axes utilize a 0 - 1 normalized scale and the labels remain horizontal, the chart is significantly simpler to read compared to the dense raw tables.

### Visualization 3:

Question 1 – Visualization 3: GDP vs Governance Scatter (2018 vs 2021)



#### Explanation (Explain what the design encodes):

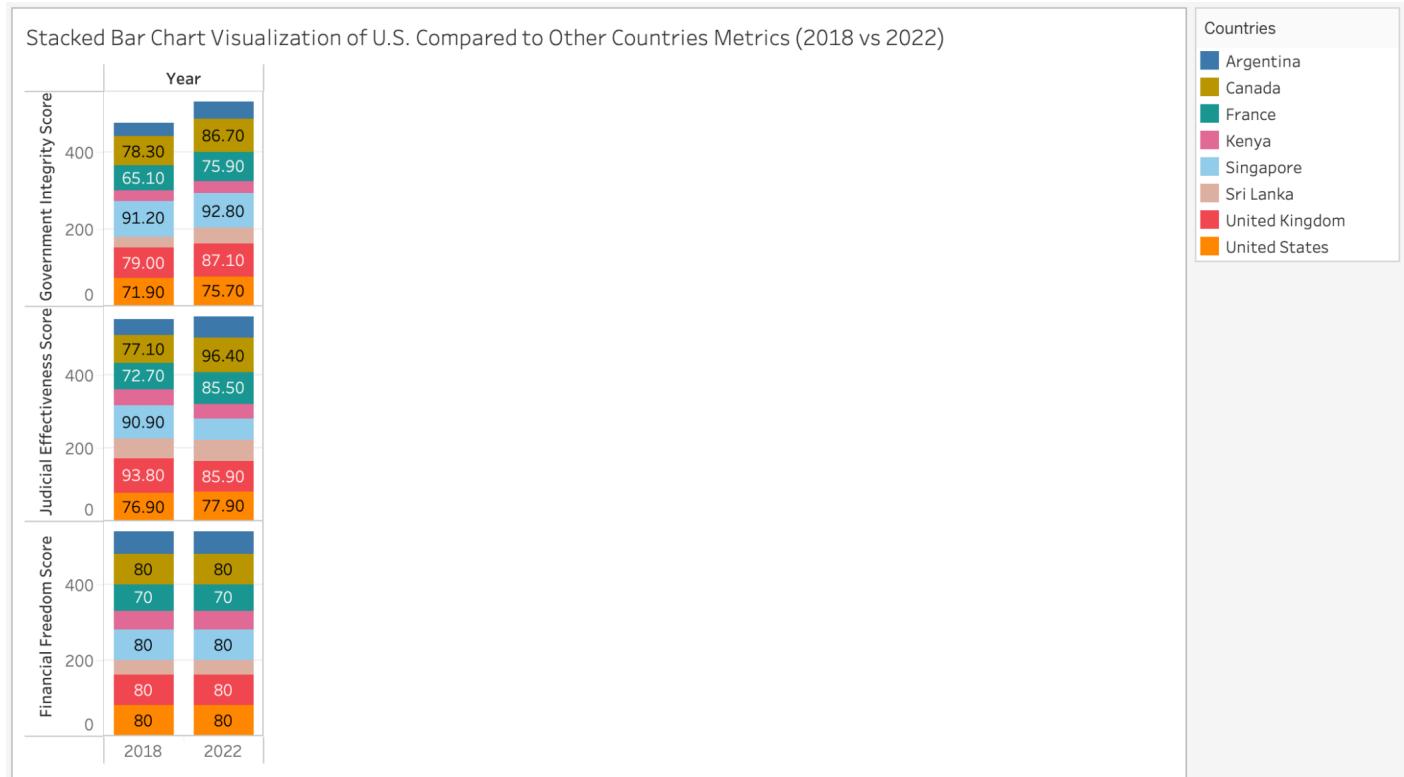
To clarify the relationship between GDP and governance, I created two adjacent scatter plots: one for 2018 (GDP per capita PPP against 2017 government effectiveness) and another for 2021 (GDP per capita PPP against 2021 governance) involving 156 nations. Points remain color-coded according to continent, and the common y-axis illustrates the tightening of the regression line by 2021. Annotated instances from the United States, China, India, Norway, Botswana, and Nigeria illustrate how various regions progressed: China moves significantly to the right and upward between panels, India trends upward, whereas the United States declines slightly in governance even with a higher income. This dual perspective maintains a straightforward visual, emphasizes changes over time, and eliminates the confusion of arrow symbols.

**Critique (Summarize pros and cons of designs):**

The three designs offer different strengths for understanding how many metrics relate across countries and years. The dual correlation heatmaps provide the clearest high-level overview because they compress all relationships among indicators into an immediately readable statistical structure, and the side-by-side 2018 and 2021 matrices make it easy to see how these relationships shift over time. However, they require some statistical familiarity, and the density of labels can be visually overwhelming. The parallel coordinates design excels at showing multivariate patterns for many countries in one place and reveals continent-level trends and year-to-year changes, but it becomes visually cluttered when many lines overlap and is less intuitive for general audiences. The paired scatterplots are the easiest to interpret because they use a familiar visual form and make the GDP governance relationship clear, especially with the annotated countries and shared axes, but they only show two metrics and therefore offer a narrower perspective than the other two charts. Together, the three designs complement one another by balancing statistical breadth, multi-metric comparison, and intuitive clarity, though each carries its own tradeoffs in readability and depth.

**Question 2: For a given country (USA), how do the other countries/regions compare to it in terms of the metrics? In this question, you must include multiple years in your data table, and you don't have to use all the metrics (but more than one metric is required).**

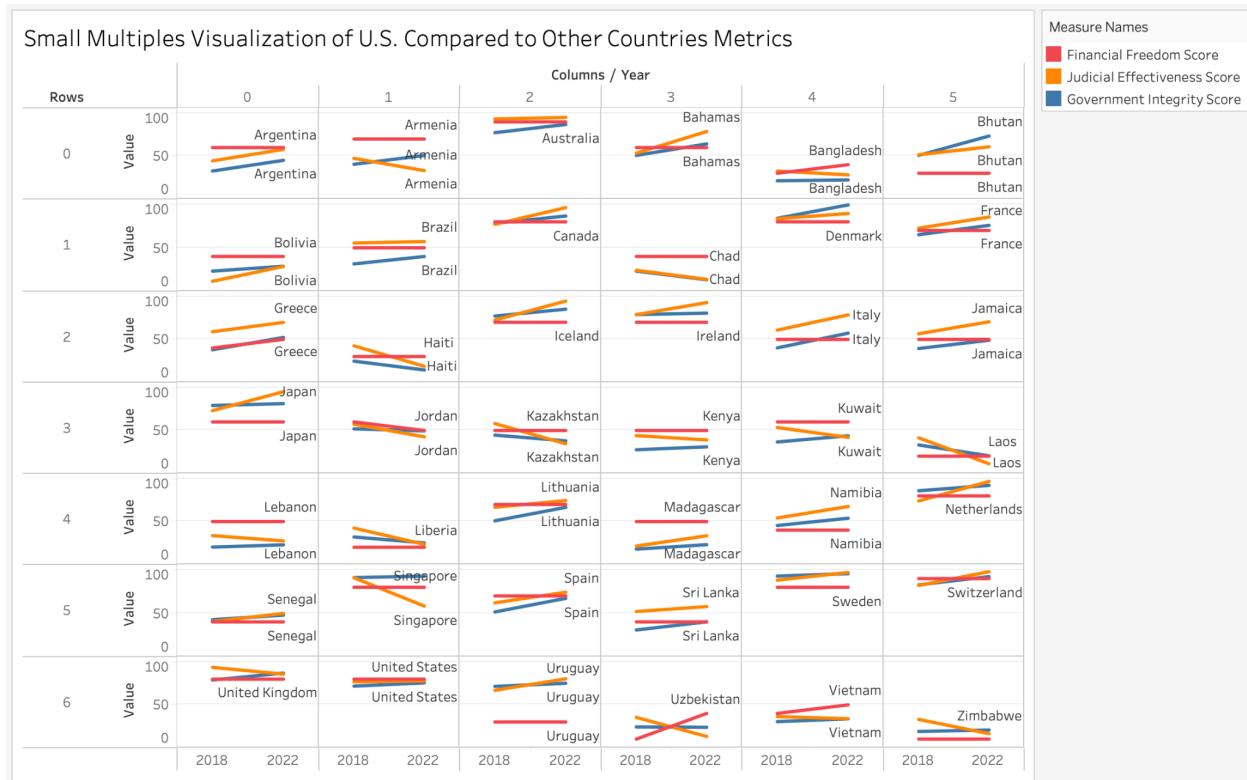
### Visualization 1:



### Explanation (Explain what the design encodes):

This is a stacked bar chart visualization which represents the level of scores for categories such as Financial Freedom, Judicial Effectiveness, and Government Integrity for the United States (U.S.) and 7 countries. The colors in a bar represent the 8 countries and the bar itself represents a year, and in this visualization the two bars for a score category such as Financial Freedom represent the years 2018 and 2022. The bar charts are separated by the score categories. Since there are three categories in this visualization, there are three stacked bar charts. From this visualization, you would be able to tell that metrics such as the Judicial Effectiveness score was pretty high in countries such as Canada and France in the year 2022 compared to the U.S. But in 2018, the U.S. had a greater score in Judicial Effectiveness than Canada and France. It shows how there was an inverse trend between the Judicial Effectiveness scores for the U.S. and Canada.

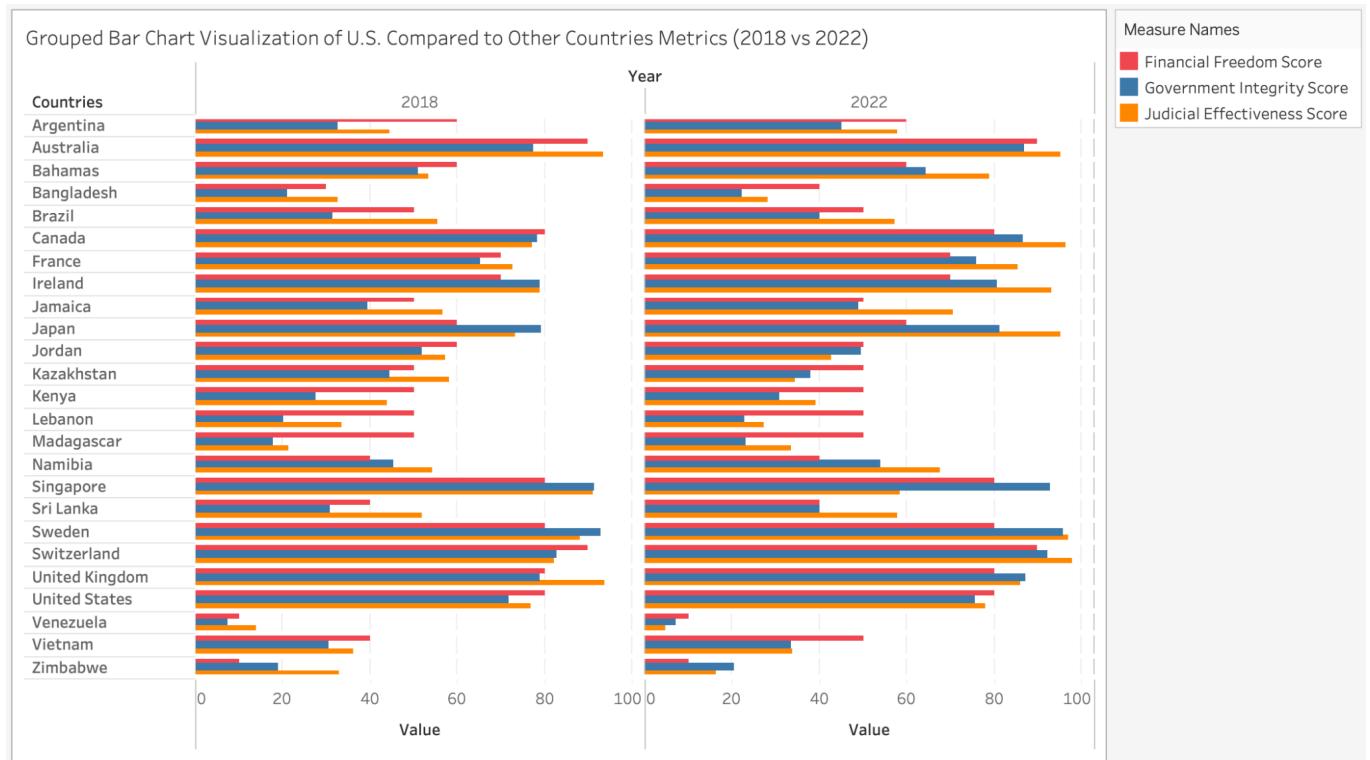
## Visualization 2:



### Explanation (Explain what the design encodes):

This is a small multiples visualization of line graphs where the x axis is the year 2018 and 2022 and the y axis is the score values between 0 to 100. The colors represent the score categories such as Financial Freedom, Judicial Effectiveness, and Government Integrity. Furthermore, each graph represents a country and in this visualization 42 countries are represented. This visualization can be used to make comparisons between the metrics of the United States (U.S.) with the metrics of other countries because the graphs being besides each other makes it easier to identify patterns quickly. For example, from this visualization, you would be able to see that there isn't a significant jump between the scores from 2018 and 2022 for Judicial Effectiveness for the U.S. compared to countries such as Singapore, Italy, and Bolivia. You could also see from this visualization that the Financial Freedom scores for the U.S., Uruguay, and the United Kingdom remained pretty constant from the year 2018 and 2022.

### Visualization 3:



### Explanation (Explain what the design encodes):

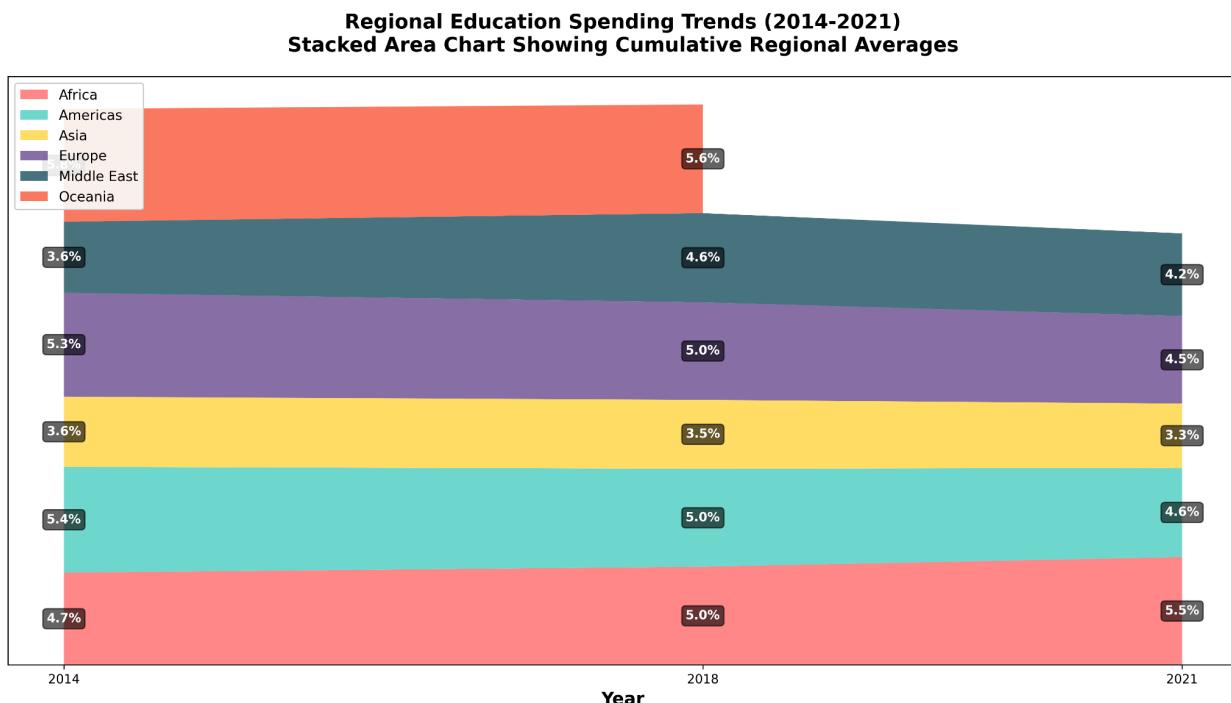
This visualization has two grouped bar charts comparing the Financial Freedom, Government Integrity, and Judicial Effectiveness scores between the United States (U.S.) and 24 countries from the years 2018 and 2022. The colors in the grouped bar charts represent the different categories of scores, for example blue represents the Government Integrity score and red represents the Financial Freedom score. The three bars grouped together represent the scores of Financial Freedom, Government Integrity, and Judicial Effectiveness for a single country. The countries are represented by the y axis. Since this visualization compares the metrics of the U.S. with other countries, it shows how the United States has a lower Government Integrity score compared to countries such as Australia, Japan, and Singapore. Additionally, information such as how the level of financial freedom is greater in the U.S. compared to countries such as Bangladesh or Venezuela is also represented in the visualization.

**Critique (Summarize pros and cons of designs):**

The three designs compare the United States to other countries in clear but different ways, each with its own tradeoffs. The stacked bar charts give a quick sense of how the U.S. ranks within each metric and year, but the stacking makes it harder to compare countries directly, especially when colors repeat. The small multiples layout makes trends over time very easy to see because each country gets its own panel, but the large number of charts can feel overwhelming and makes side-by-side comparisons slower. The grouped bar charts are the most straightforward for directly comparing the U.S. to each country in 2018 and 2022, but the view becomes crowded with many bars and requires shifting between the two year panels. Overall, all three designs help answer the question, but each one balances clarity, detail, and scalability differently.

**Question 3: For a given metric (education as a percentage of GDP), how do different countries and regions perform? In this question, you must include multiple years in your data table.**

**Visualization 1:**

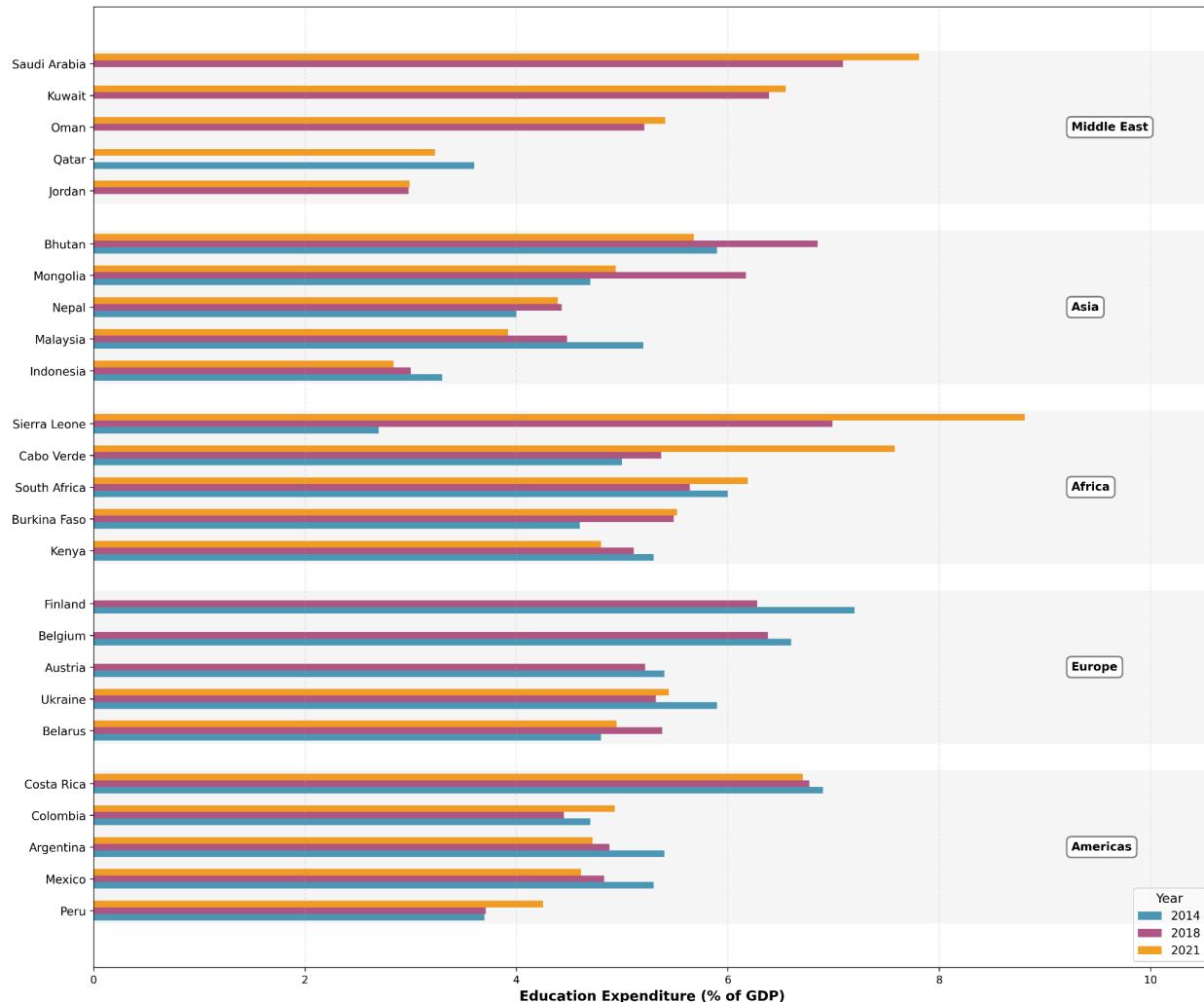


**Explanation (Explain what the design encodes):**

The stacked area chart shows how much different regions of the world spend on education as a percentage of their GDP. The height of each colored band shows how much that region spends and as the height changes, you can see how that region's spending changed over time. The regions are distinguished by using different colors. The average for each region for each year is labeled within the area for that region.

## Visualization 2:

**Education Spending by Country Within Each Region (2014, 2018, 2021)**  
Top 5 Countries per Region

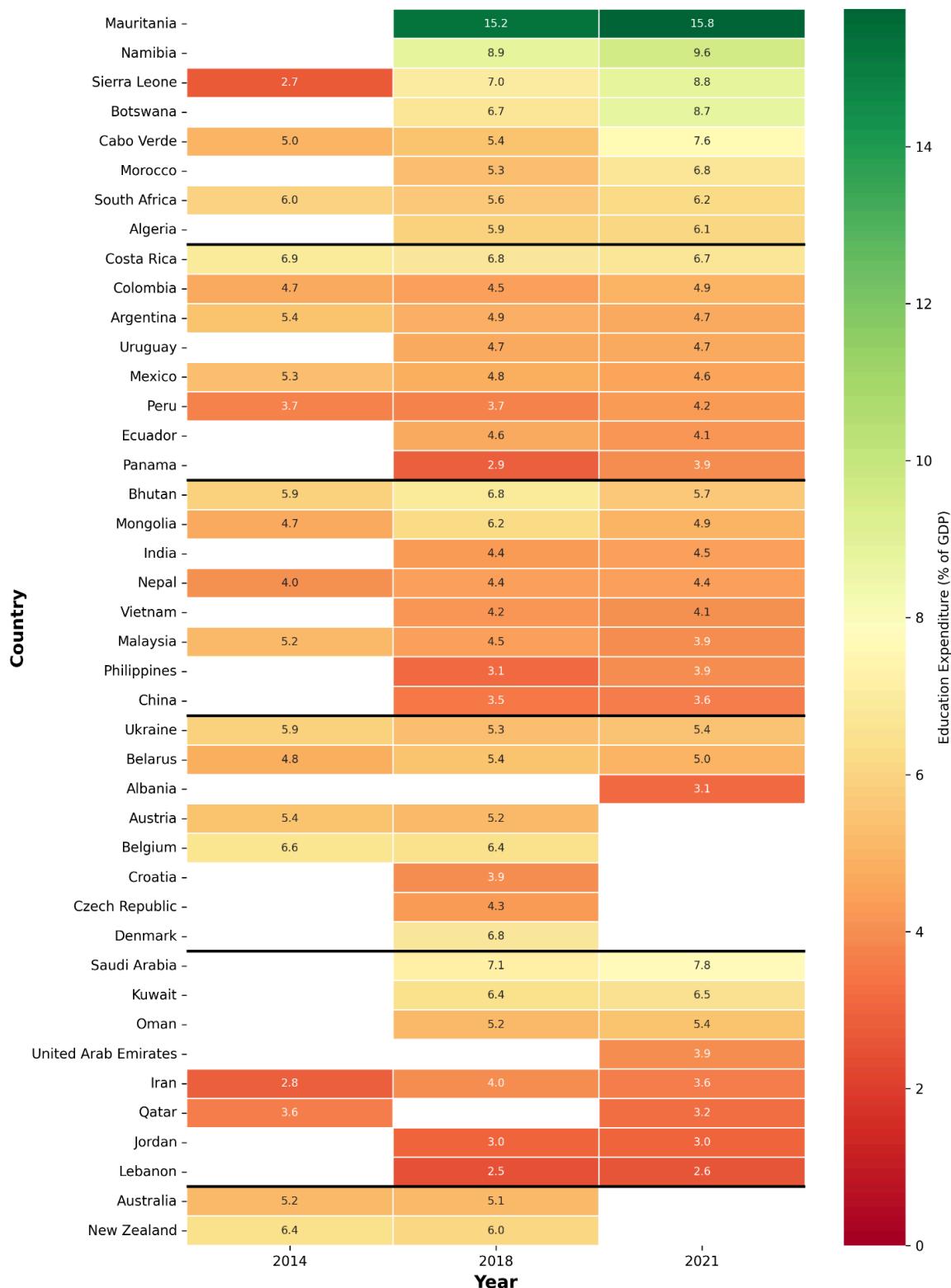


### Explanation (Explain what the design encodes):

This horizontal bar chart displays education expenditure as a percentage of GDP for the top 5 countries in each of the 6 world regions across three years (2014, 2018, 2021). Each country has three colored bars; blue for 2014, red/pink for 2018, and orange for 2021, allowing direct comparison of how education spending evolved over this period. Countries are grouped by region with shaded backgrounds and labels on the right side. The bar length encodes the spending percentage, making it easy to identify both the highest-performing countries within each region and whether their investment in education increased, decreased, or remained stable over time.

### Visualization 3:

**Education Expenditure Heatmap by Country and Region (2014-2021)**  
**Top 8 Countries per Region | Darker Green = Higher Spending**



### **Explanation (Explain what the design encodes):**

Each row represents a country, and each column represents a year, with the cell color encoding the spending level, darker green indicates higher expenditure while lighter yellow and red/orange indicate lower expenditure. Countries are grouped by region (separated by black horizontal lines) and sorted by their spending levels within each region, making it easy to identify the highest and lowest performers. The annotated percentages within each cell provide precise values, allowing readers to see both cross-sectional comparisons (which countries spend more in a given year) and temporal trends (how individual countries' spending changed over the 7-year period).

### **Critique (Summarize pros and cons of designs):**

The heatmap does a great job showing all the data at once with its grid layout and exact percentage values, making it easy to compare countries across different years and see how spending changed over time, while grouping countries by region and sorting them helps organize everything clearly. However, with so many countries shown, it can feel overwhelming and hard to quickly spot the main trends, plus having both colors and numbers in each cell might be more than necessary. The horizontal bar chart works well by only showing the top 5 countries from each region, which makes it less cluttered and easier to focus on the best performers, and the three bars per country (one for each year) clearly show whether spending went up or down over time; the downside is that we lose information about countries that aren't in the top 5, and comparing across all six regions at once can still be visually busy. The stacked area chart gives a nice big-picture view of how each region's average spending changed over the years, with different colors making regions easy to tell apart and labels built right into the chart; but it completely hides individual country data, and because the regions are stacked on top of each other, it's hard to accurately compare regions that aren't at the bottom, plus using averages means we miss seeing if some countries in a region are very different from others.