

Analysis of Global Cost of Living

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Introduction:

This study focuses on analyzing the cost of living across different regions globally in 2022. Our findings indicate that Asia has the lowest cost of living, while Europe has the highest. According to the United States Bureau of Labor Statistics, "the CPI frequently is called a cost-of-living index, ...Since the CPI does not attempt to quantify all the factors that affect the cost-of-living, it is sometimes termed a conditional cost-of-living index." In our research, we consider the Consumer Price Index (CPI) as the primary factor influencing the cost of living. Our study aims to hold CPI as an independent variable, and to explore the relationships and impacts against unemployment rates, income inequality, and national GDP (Gross Domestic Product) from 2000 to 2022, focusing on countries in the continents of Europe, Asia, and North America. The first section will detail why we chose to focus on these particular continents, and the remaining three sections will look at the relationship between CPI and a certain economic indicator, gauging their strength. Ultimately, we want to see if the conclusions we reach about correlations with CPI are telling to the trends of the global cost of living.

Methodology

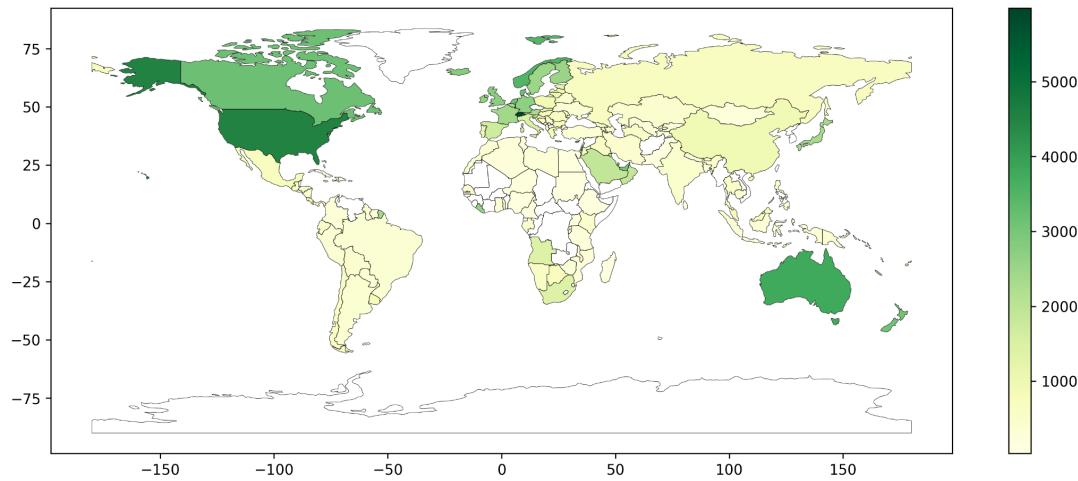
1. Global Cost of Living

We first sought out to see how the cost of living differs around the world. We wanted to identify the continents with the greatest and least cost of living, so we can see which economic indicator has the greatest impact on CPI in these places, and is that striking to trends of the global cost of living.

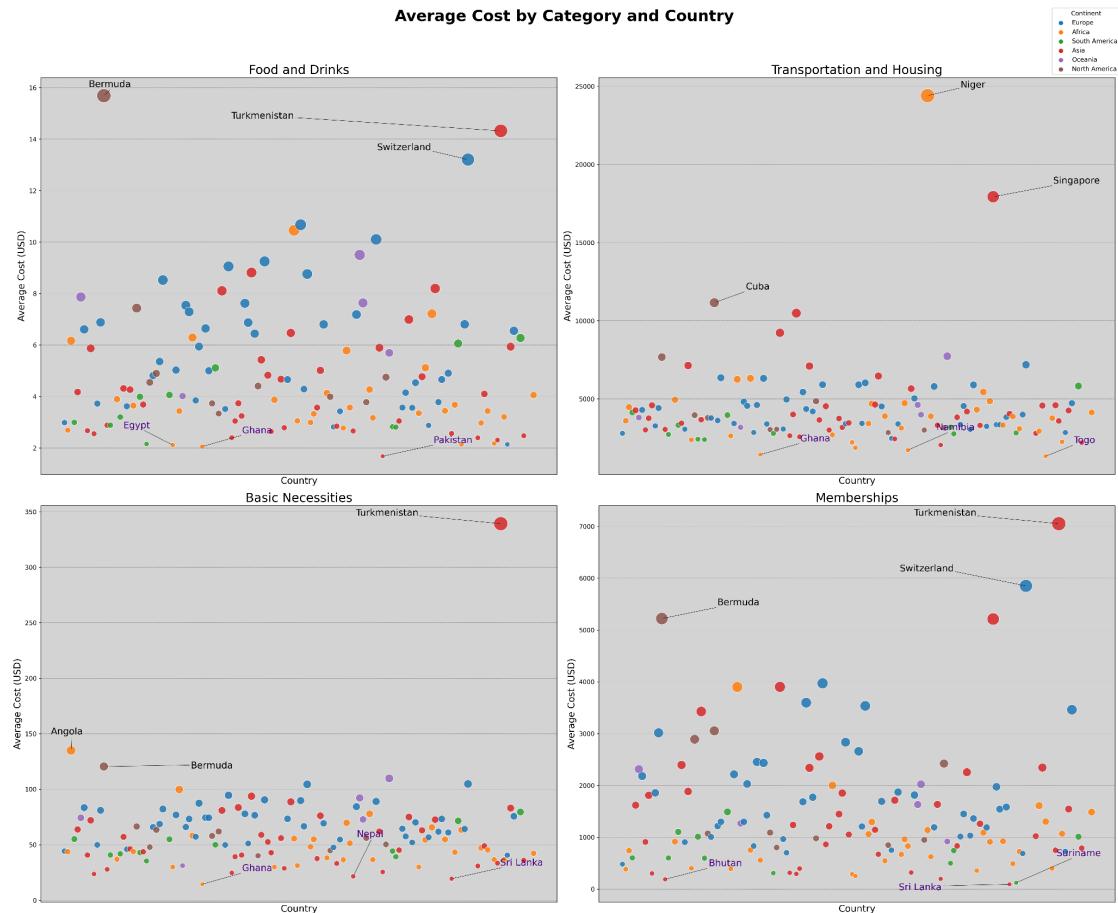
Overview

The following map shows the average monthly net salary in USD after taxes by country. The axes represent the geographical coordinates, where the y-axis shows the latitude and the x-axis shows the longitude. The color gradient map represents the average monthly net salary, coloring the countries based on the salary amount. So, the darker the green, the higher the average monthly net salary. As seen, many countries in the continent of Africa, as well as other parts of the world, are not shaded; they indicate there was no data available to portray the average monthly net salary. From the map, we can see the United States of America, Switzerland, Australia, and Canada all have a high average monthly net salary. Continent-wise, North America and Europe have a robust monthly salary, whereas Asia has a weak monthly salary. Further analysis will reveal which countries have a higher or lower cost overall.

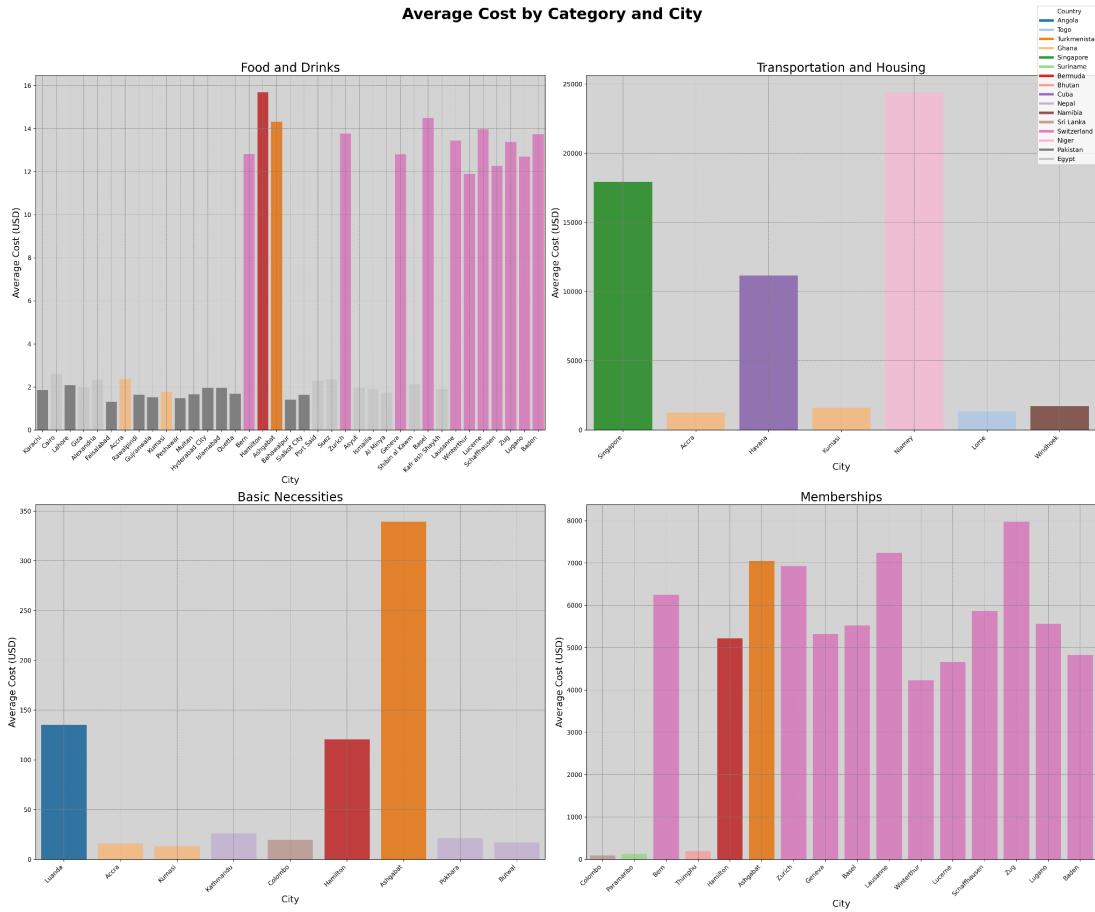
Average Monthly Net Salary by Country (USD)



The columns of the dataset can be classified into 4 broader categories: Food and Drinks, Transportation and Housing, Basic Necessities, and Memberships. This separation can help determine if the cost of these categories significantly varies around the world. So, a series of 4 scatter plots is generated, showing the average cost, in USD, by category and country. Each point depicts a specific country, and they are color-coded by continents as seen in the legend. The size of the point equates to the average cost, so the bigger the point, the greater the average cost for that particular category. The top 3 and least 3 expensive countries are labeled for each category, in black and indigo respectively.



There are a total of 16 countries that fall within the top 3 or least 3 expensive across the categories. We can take a look at the cities within these countries, plotting a bar plot that shows the average cost by category and city. This time, the bars are color-coded by country, and the thickness is representative of the average cost.



For the 16 countries identified earlier, a table can be produced that compares prices for basic, daily items that an average bachelor needs. Here, a bachelor is defined as a single, childless man who lives in the city, so he does need a car; he also has a full time job. The required items are food, water, internet, a 1 bedroom apartment, and his salary. The average cost for each of these items, per the 16 countries is taken and appended to the table.

	Country	Meal, Inexpensive Restaurant (USD)	Water (0.33 liter bottle, in restaurants) (USD)	Internet (60 Mbps or More, Unlimited Data, Cable/ADSL) (USD)	Apartment (1 bedroom) in City Centre (USD)	Average Monthly Net Salary (After Tax) (USD)	Average Cost (USD)
0	Pakistan	1.35	0.17	20.66	80.49	155.31	51.60
1	Egypt	3.45	0.15	14.49	117.19	162.72	59.60
2	Nepal	2.42	0.17	15.28	111.98	252.11	76.39
3	Sri Lanka	1.36	0.18	9.98	295.69	156.07	92.66
4	Bhutan	3.06	0.16	20.40	152.70	365.25	108.31
5	Cuba	10.00	1.63	165.00	353.33	35.75	113.14
6	Suriname	4.86	0.74	37.50	394.71	234.55	134.47
7	Ghana	2.05	0.12	32.94	348.34	307.64	138.22
8	Niger	3.96	0.85	11.88	533.06	208.49	151.65
9	Togo	1.98	1.27	58.48	255.34	527.83	168.98
10	Namibia	8.76	0.74	43.05	390.40	576.47	203.88
11	Turkmenistan	28.49	0.68	338.32	591.17	560.30	303.79
12	Angola	7.84	1.42	192.23	220.39	1428.77	370.13
13	Singapore	10.92	1.04	34.37	2660.73	4497.08	1440.83
14	Switzerland	26.80	3.92	55.55	1589.09	5981.58	1531.39
15	Bermuda	29.00	2.43	142.00	3250.00	5973.81	1879.45

Findings and Discussion

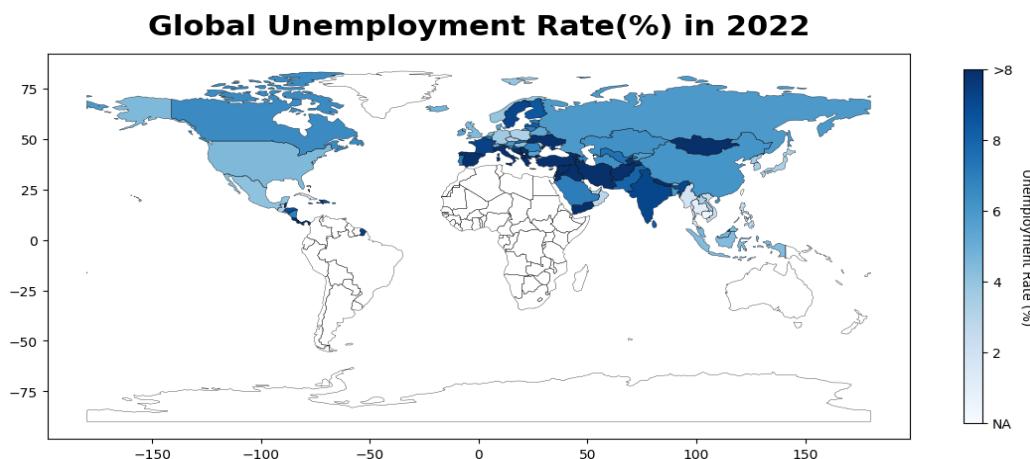
From the 2 plots and table, we can see which countries and cities have a higher or lower average cost. Looking at the scatterplot, we can deduce that Turkmenistan, Switzerland, and Bermuda are frequently expensive countries, whereas Ghana and Sri Lanka are frequently least expensive countries. When looking at the continents, Europe has a higher average cost, as highlighted with the majority of the blue points residing in the upper half of each subplot. Asia and Africa have a lesser average cost, shown with the red and orange points. Analyzing the bar plot, similar findings are revealed, where cities in Switzerland have a greater average cost, and cities in Pakistan and Ghana have a lesser average cost. Lastly, the table reaffirms the same results, where Asian countries have the least average cost and European countries have the greatest average cost. So, we can conclude Europe has the highest global cost of living, and Asia has the least. We want to see if these continents have always had these trends, which is why we will examine the relationship between CPI and various economic indicators to determine this. We decided to add North America as a third continent to analyze because we reside here, and it would be interesting to find out how it compares against Europe and Asia.

2. Unemployment Rate and CPI

We hypothesized a correlation between the unemployment rate and the CPI. The Phillips Curve theory suggests an inverse relationship between inflation rates and unemployment rates—higher inflation typically is associated with lower unemployment, and vice versa. The goal is to explore whether this theory holds when comparing unemployment rates with the CPI, a key indicator of inflation. Our objective is to analyze historical data to understand how these two critical economic indicators interact, focusing on their correlation and potential impacts.

Overview

The following map displays the unemployment rates in North America, Asia, and Europe in 2022 (the intensity of blue represents the level of unemployment rates). We set an 8% cap for the unemployment rate, as rates above this threshold typically indicate high unemployment, often associated with recessions or industrial restructuring. The map reveals that most countries in these continents have unemployment rates around 5%, with North America having a generally lower rate compared to Asia and Europe. However, some countries in Asia and Europe exhibit unemployment rates greater than 8% (indicated by darker blue). We will further analyze the connection between unemployment rates and CPI in these continents in subsequent analyses.



The following scatter plots represent the relationship between CPI and unemployment rates for countries in Asia, Europe, and North America. The x-axis represents the CPI (annual %), and the y-axis represents the unemployment rate.

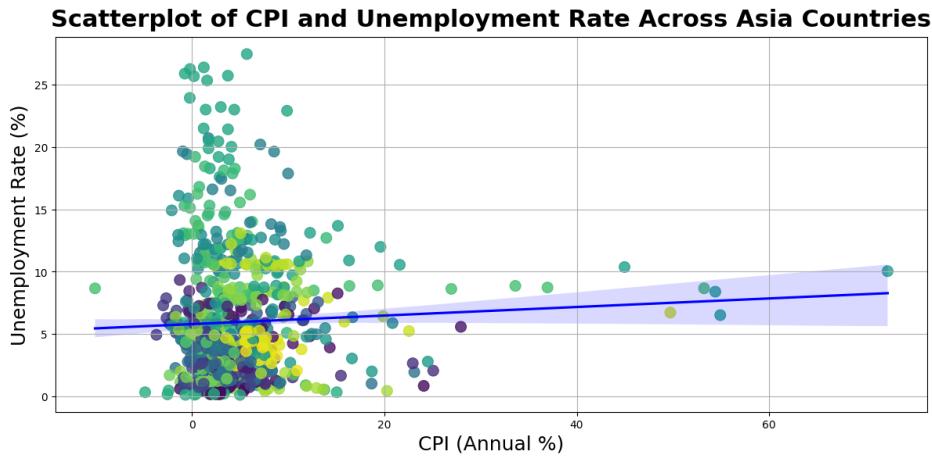


Figure: This scatter plot displays the relationship between the CPI and unemployment rate for various countries in Asia across multiple years.
No clear general pattern can be discerned from this plot, highlighting the diverse economic dynamics within the region.

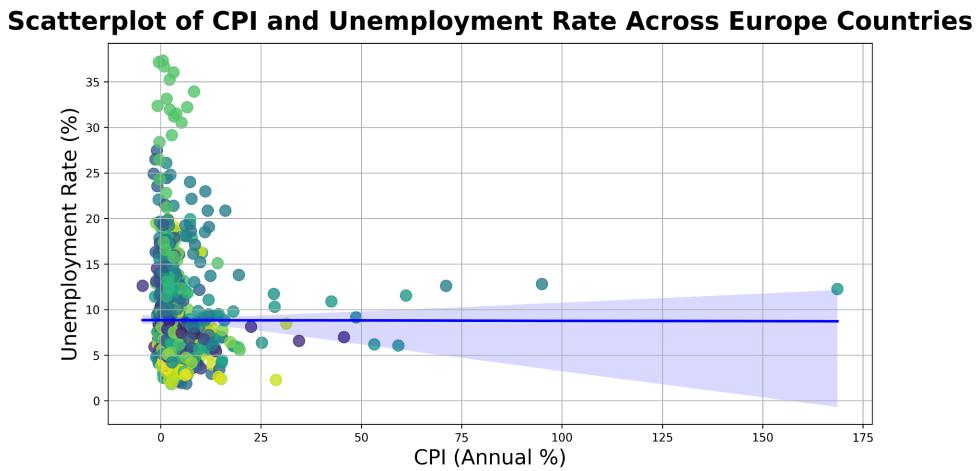


Figure: This scatter plot displays the relationship between the CPI and unemployment rate for various countries in Europe across multiple years.
No clear general pattern can be discerned from this plot, highlighting the diverse economic dynamics within the region.

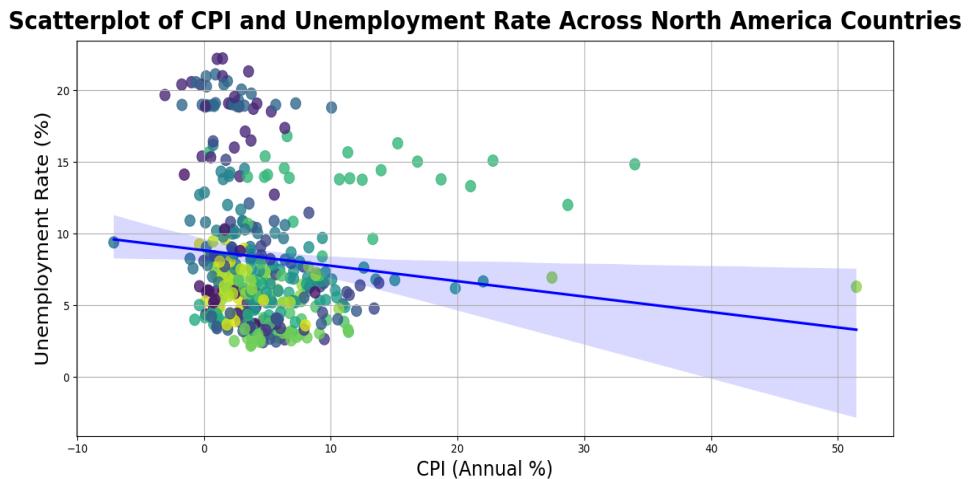


Figure: This scatter plot displays the relationship between the CPI and unemployment rate for various countries in North America across multiple years.
A general negative correlation is observed, as indicated by the regression line.

In the following analysis, we abandoned using the CPI and unemployment rates of all countries in each continent. Instead, we used the median of the unemployment rate and CPI for the 3 continents of interest, analyzing the change in these medians from 2000 to 2022 to explore their interconnection. The following are line graphs for the three continents, with the x-axis representing the years (2000-2022) and the y-axis representing percentages. The red line represents the median unemployment rate, and the blue line represents the median CPI. Vertical green dashed lines at 2008 and 2020 represent two significant global events: the global economic crisis and the COVID-19 pandemic.

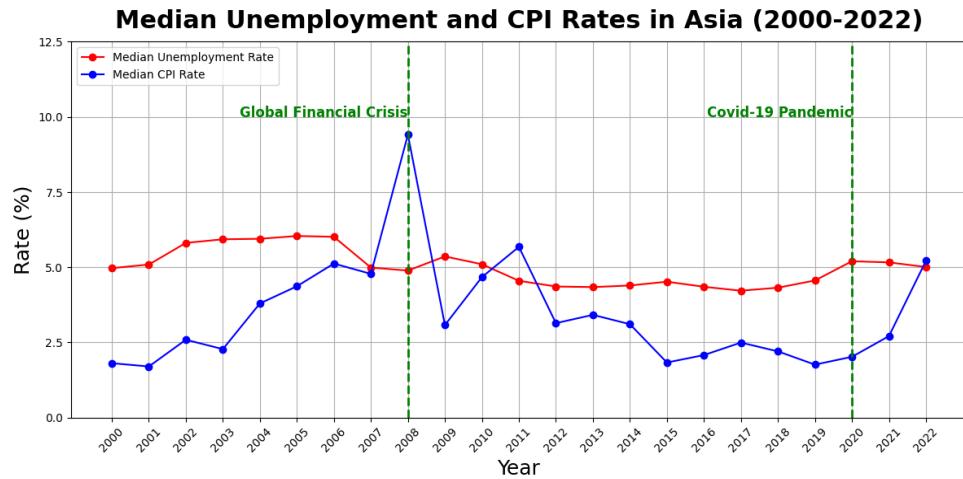


Figure: This line chart compares the median CPI with the unemployment rate in Asia from 2000 to 2022. While a clear long-term relationship is not evident, a negative correlation becomes noticeable around major global events in 2008 and 2020.

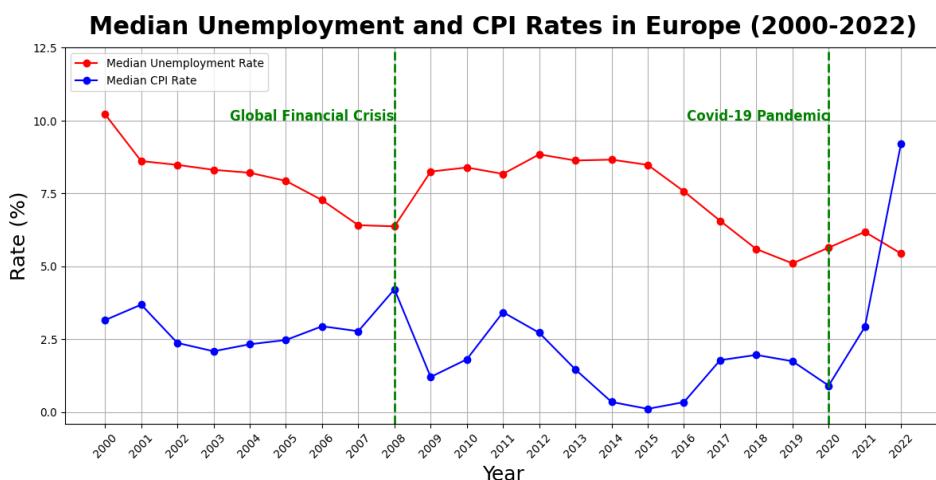


Figure: This line chart compares the median CPI with the unemployment rate in Europe from 2000 to 2022. A clear long-term negative relationship is evident, particularly around major global events in 2008 and 2020, where this correlation becomes more pronounced.

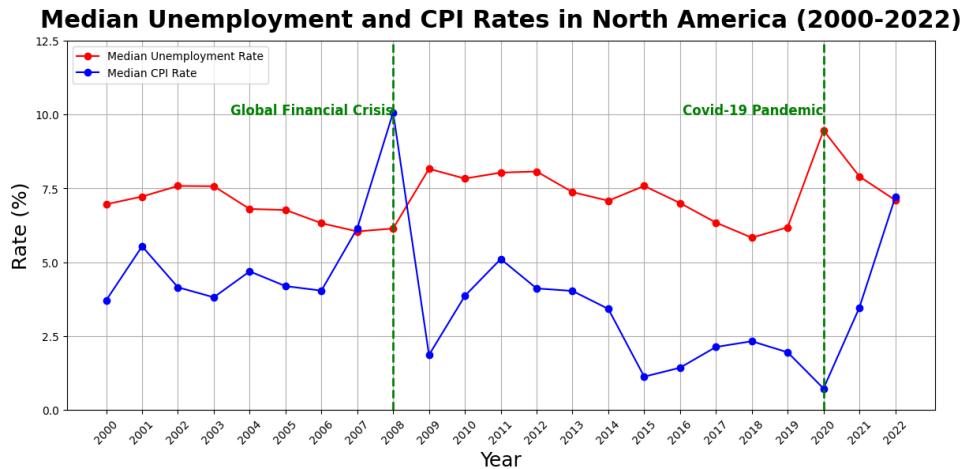


Figure: This line chart compares the median CPI with the unemployment rate in North America from 2000 to 2022.

A long-term relationship is not evident, but in multiple short terms, a negative correlation is observed. This correlation is most pronounced particularly around major global events in 2008 and 2020.

Findings and Discussion

From the analysis of the scatter plots, it is challenging to discern a clear correlation between CPI and unemployment rates across different continents. This could be due to extremes in CPI and unemployment rates affecting the analysis. Additionally, fluctuations in CPI are influenced by many factors beyond unemployment rates, complicating the correlation analysis. Furthermore, the CPI indices of different countries are also affected by national policies and regional differences. The analysis of these line graphs reveals that in Asia, despite changes in the CPI, the median unemployment rate remains relatively stable, indicating a weak or unclear relationship between the two. In contrast, in Europe and North America, we observe a generally inverse correlation—CPI increases often accompany decreases in unemployment rates. This trend is more evident in certain years but was not consistently observed from 2000 to 2022. This inverse correlation aligns with the short-term effects of the Phillips Curve, where lower unemployment rates are typically associated with higher inflation. However, this relationship appears to fluctuate over time, with certain years showing a clear inverse correlation, while others do not follow the expected pattern. The vertical green dashed lines in the line graphs mark 2008 and 2020, denoting the global financial crisis and the COVID-19 pandemic, respectively. In Asia, Europe, and North America, these global events led to significant fluctuations in both CPI and unemployment rates. Post-2008, the continents experienced a significant decrease in CPI and a corresponding increase in unemployment rates, reflecting the impact of the financial crisis. Conversely, during the 2020 COVID-19 pandemic, we observed a sharp rise in CPI with a general downward trend in unemployment rates, suggesting complex economic responses to the pandemic.

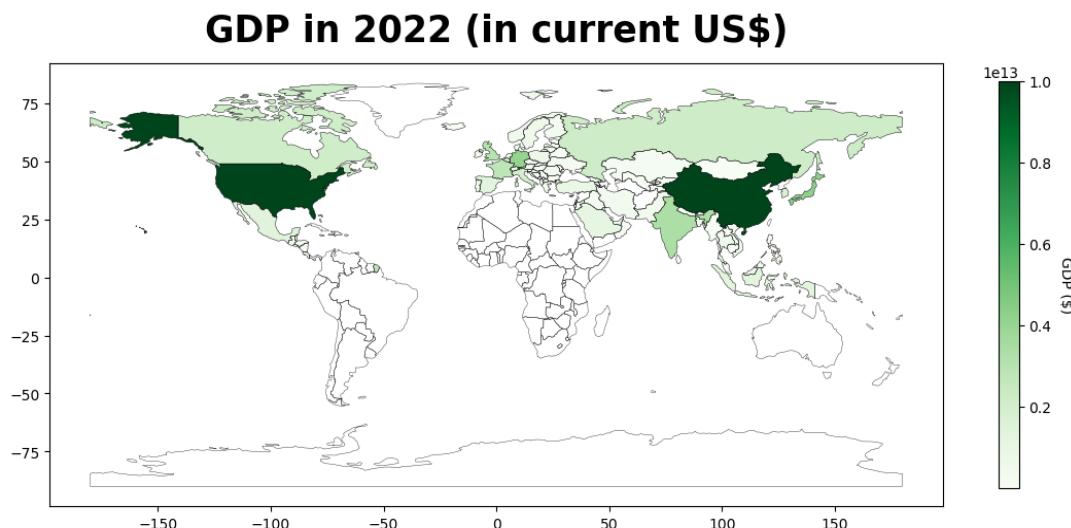
3. GDP and CPI

The Phillips Curve theory, which indicates an inverse relationship between inflation and unemployment, suggests that high employment levels associated with economic growth can initially lead to increased consumer demand, thereby raising inflation (CPI). However, if inflation becomes too high, it can harm economic growth (GDP) due to various mechanisms. For

instance, persistent high inflation erodes consumers' purchasing power, leading to decreased consumer spending, a vital component of GDP. It also increases business costs, which can reduce investment and slow down economic activity. Additionally, to curb inflation, central banks may raise interest rates, resulting in less borrowing and spending, further decelerating GDP growth. Thus, while short-term economic expansion may cause a temporary rise in CPI, over the long term, the Phillips Curve theory implies that sustained high CPI can inversely affect GDP as the economy adjusts to the adverse effects of high inflation. Hence, we want to analyze the relationship between CPI and GDP, seeing if we can find similar conclusions.

Overview

The map presented below illustrates GDP by country for the year 2022, with the color intensity reflecting the magnitude of GDP in current US dollars. We set a cap of 1×10^{13} for the GDP, as values above this threshold typically indicate a high GDP level. The color scale represents the GDP amount, where darker shades entail a higher economic output. Notably, countries with the darkest green have GDP figures that far exceed those of other nations, which is often reflective of larger economies with significant industrial and service sectors. It is evident that North America, along with parts of Asia, such as China and India, exhibit substantial GDP figures. Europe also shows varying shades of green, suggesting a diverse economic landscape across the continent. This map sets the stage for a more nuanced analysis of economic factors, such as the interplay between GDP and CPI, as well as the exploration of GDP in relation to other economic indicators across these keys.



The following scatter plots represent the relationship between CPI and GDP growth rate for countries in Asia, Europe, and North America. The x-axis represents the CPI (annual %), and the y-axis represents the GDP growth rate (%).

Scatter Plot of CPI vs GDP Growth Rate for Asian Countries

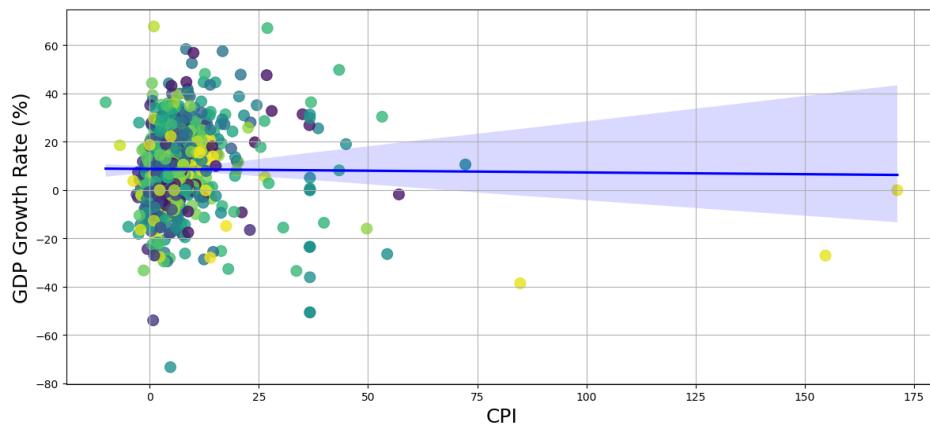


Figure: This scatter plot displays the relationship between the CPI and GDP growth rate for various countries in Asia across multiple years.

No clear general pattern can be discerned from this plot, highlighting the diverse economic dynamics within the region.

Scatter Plot of CPI vs GDP Growth Rate for European Countries (2000-2022)

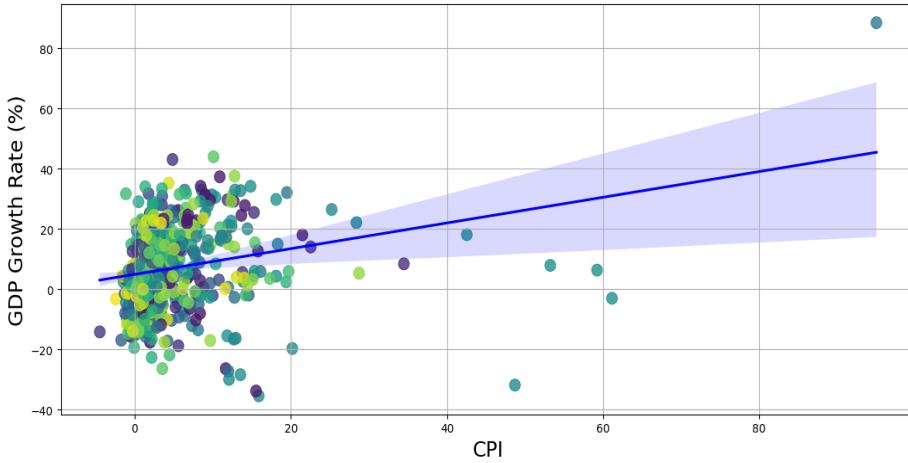


Figure: This scatter plot displays the relationship between the CPI and GDP growth rate for various countries in Europe across multiple years.

No clear general pattern can be discerned from this plot, highlighting the diverse economic dynamics within the region.

Scatter Plot of CPI vs GDP Growth Rate for North American Countries (2000-2022)

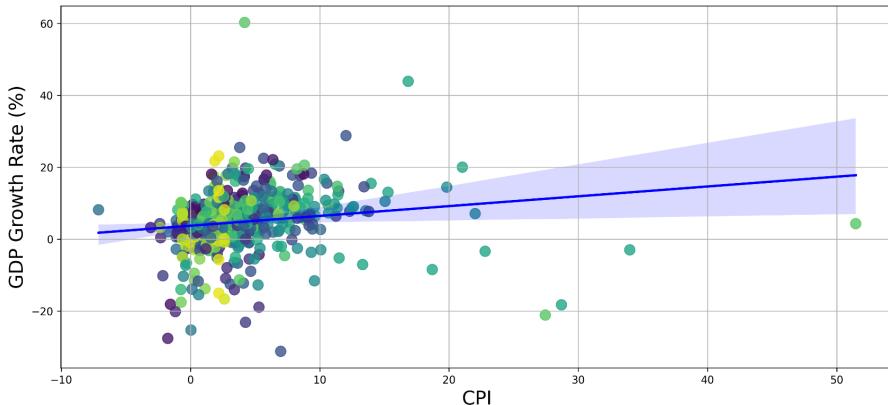


Figure: This scatter plot displays the relationship between the CPI and GDP growth rate for various countries in North America across multiple years.

No clear general pattern can be discerned from this plot, highlighting the diverse economic dynamics within the region.

Similarly, we used the median of the GDP growth rate and CPI for the 3 continents, analyzing the change in these medians from 2000 to 2022. We wanted to explore their interconnection in the following analysis. The following plots are line graphs, with the x-axis representing the years (2000-2022) and the y-axis representing percentages. The red line represents the median GDP growth rate, and the blue line represents the median CPI. Vertical green dashed lines at 2008 and 2020 represent two significant global events: the global economic crisis and the COVID-19 pandemic.

Median CPI and Median GDP Growth Rate for Asian Countries (2000-2022)

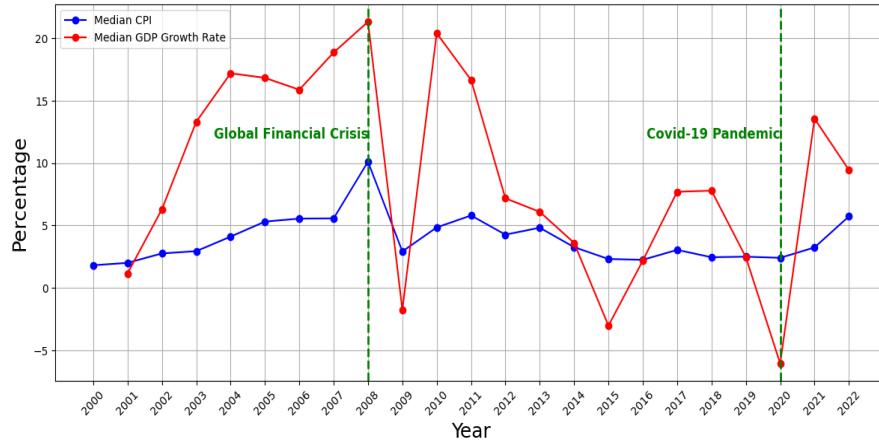


Figure: This line plots compares the median CPI with the GDP growth rate in Asia from 2000 to 2022. While a clear long-term relationship is not evident, a positive correlation becomes noticeable around major global events in 2008 and 2020

Median CPI and Median GDP Growth Rate for European Countries (2000-2022)

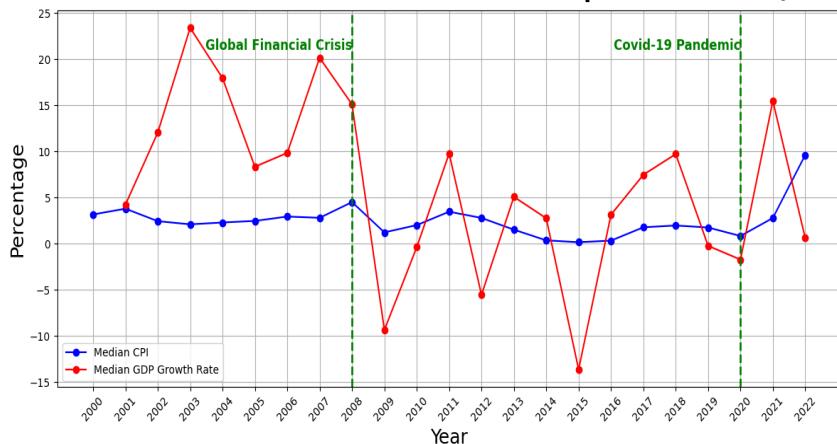


Figure: This line plots compares the median CPI with the GDP growth rate in Europe from 2000 to 2022. While a clear long-term relationship is not evident, a positive correlation becomes noticeable around major global events in 2008 and 2020

Median CPI and Median GDP Growth Rate for North American Countries (2000-2022)

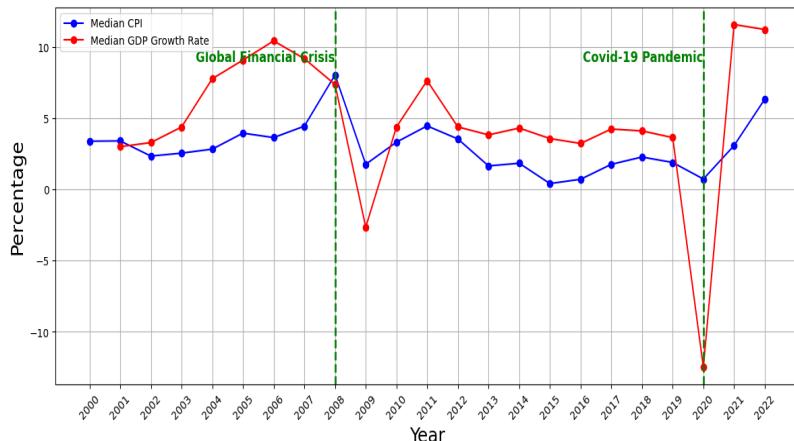


Figure: This line plots compares the median CPI with the GDP growth rate in North America from 2000 to 2022. While a clear long-term relationship is not evident, a positive correlation becomes noticeable around major global events in 2008 and 2020

Findings and Discussion

The scatter plots provide a visual representation of the relationship between CPI and GDP growth rate for Asian, European, and North American countries over multiple years. The data points are spread out across the graphs, suggesting a complex and multifaceted relationship. The dispersion of data indicates significant variability within each region, especially in Asia. The relationship between CPI and GDP growth rate varies greatly across countries and years, as the scatter plots imply the diverse economic dynamics within regions. For instance, rapid development and economic growth in Asian countries like China and Japan could lead to different CPI trends compared to others with slower growth or different economic challenges. There are apparent outliers in all regions, which could be due to extraordinary economic events or data anomalies. These outliers can significantly impact the overall correlation analysis. In terms of the line graphs, there are some key observations to be noted per continent. For Asia, the line graph indicates periods of both positive and negative correlations between CPI and GDP growth. During the global financial crisis and the COVID-19 pandemic, the CPI and GDP growth rates move together in the same direction, which is atypical. European countries show a similar pattern to Asia, with deviations from the expected inverse relationship, particularly pronounced during the global financial crisis and the COVID-19 pandemic. The North America plot reflects this anomaly the most, with the CPI and GDP growth rates displaying a synchronous movement during these crisis periods.

Potential reasons for the unusual relationship include:

- Demand and Supply Shocks: Financial crises and pandemics often lead to significant disruptions in both supply and demand in the economy. During these periods, economic activity tends to contract sharply due to reduced consumer spending, business investment, and international trade. As a result, both GDP and CPI can decline simultaneously.

- b. Deflationary Pressures: A severe economic downturn can lead to deflationary pressures. Deflation is a sustained decrease in the general price level of goods and services. As businesses struggle to sell their products and consumers cut back on spending, companies may reduce prices to attract customers. This contributes to a decline in the CPI, which measures the average change in prices of consumer goods and services.

The positive correlation observed during the global financial crisis and the COVID-19 pandemic can be attributed to extraordinary economic interventions. During crises, governments and central banks often inject liquidity into the economy and implement fiscal stimulus measures, which can simultaneously boost GDP (via increased spending) and CPI (through higher demand and sometimes supply chain disruptions). Theoretically, CPI and GDP growth should exhibit an inverse relationship, as higher inflation (reflected by CPI) can erode purchasing power and slow down economic growth. However, during a crisis, the usual market mechanisms can be altered by these interventions, leading to a temporary positive correlation.

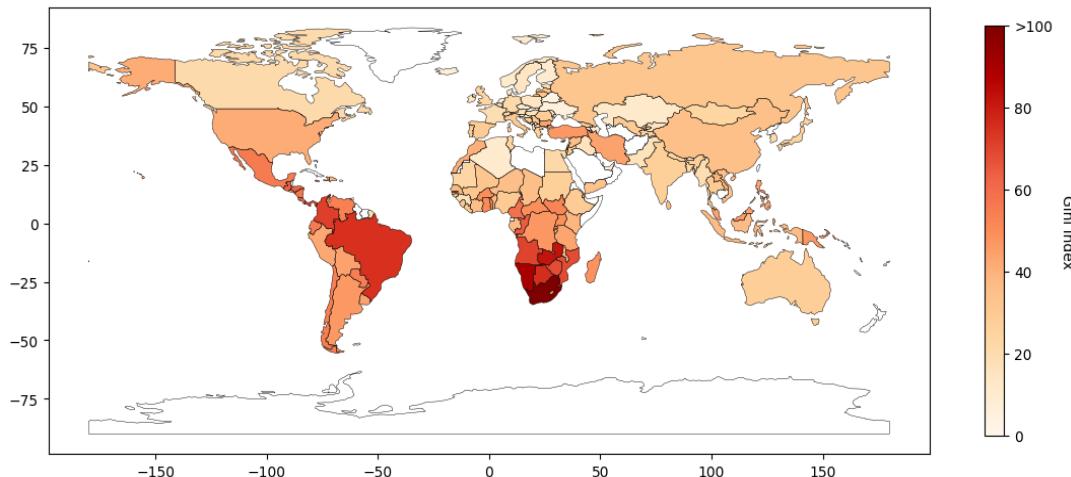
4. Income Inequality and CPI

The final economic indicator we wanted to analyze with CPI is income inequality. It is known as the uneven distribution of income among a group of people. The Gini Coefficient, a statistical measure of economic inequality in a population, will be used to determine if there is an evident relationship between CPI and income inequality.

Overview

The following map is a visualization of the 2022 Gini data. The map includes a color bar for interpreting these values, categorizing Gini Coefficients from 0.3 to 0.6. While red represents high income inequality, lighter colors like yellow indicate lower income difference.

Global Gini Coefficient(%) in 2022



In the following plots, we visualize the relationship between CPI and the Gini Coefficient in Asia, Europe and North America. The structure of the plots remains the same as in the previous part; the only difference is we look at the Gini Index now.

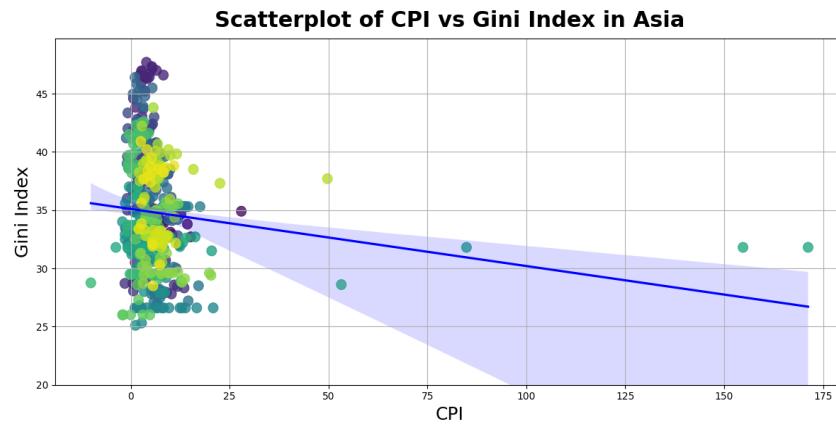


Figure: This scatter plot displays the relationship between the CPI and Gini coefficient for countries in Asia from 2000 to 2022.
A significant negative correlation is observed.

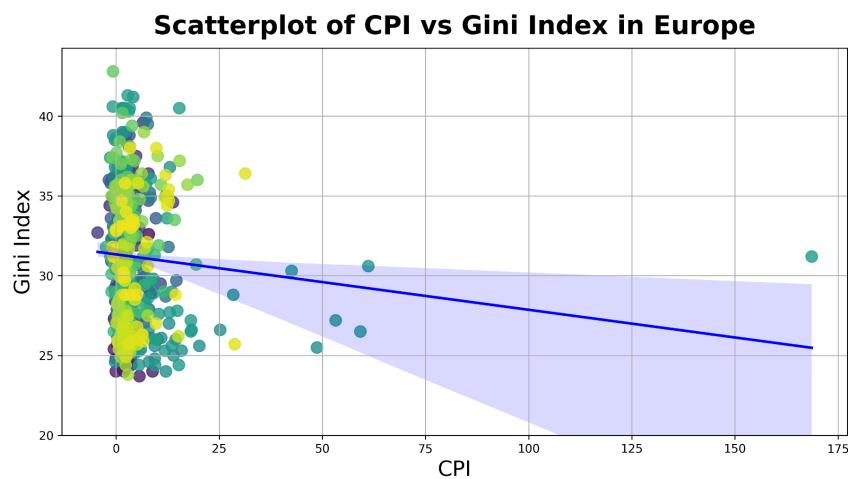


Figure: This scatter plot displays the relationship between the CPI and Gini coefficient for countries in Europe from 2000 to 2022.
A significant negative correlation is observed.

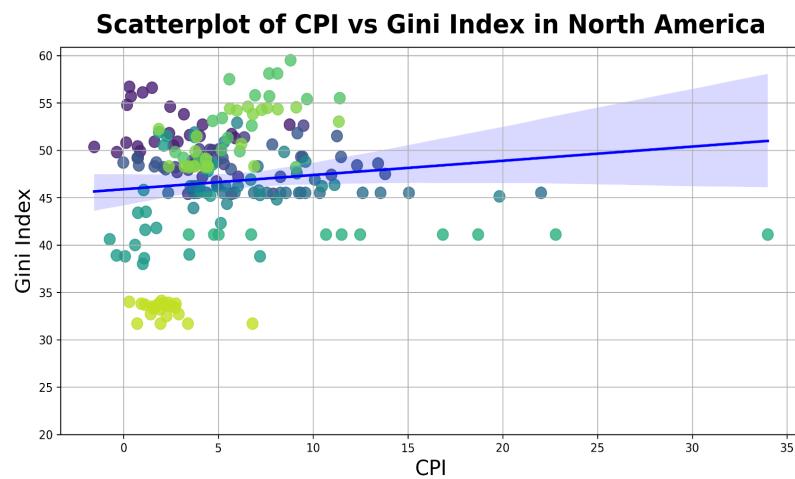


Figure: This scatter plot displays the relationship between the CPI and Gini coefficient for countries in North America from 2000 to 2022.
A significant positive correlation is observed.

We also plotted a series of line plots, with the y-axis being the median CPI and the x-axis being the Gini Index. These figures, separated by the 3 continents of interest, show the trends of the Gini Coefficient and CPI from 2000 to 2022.

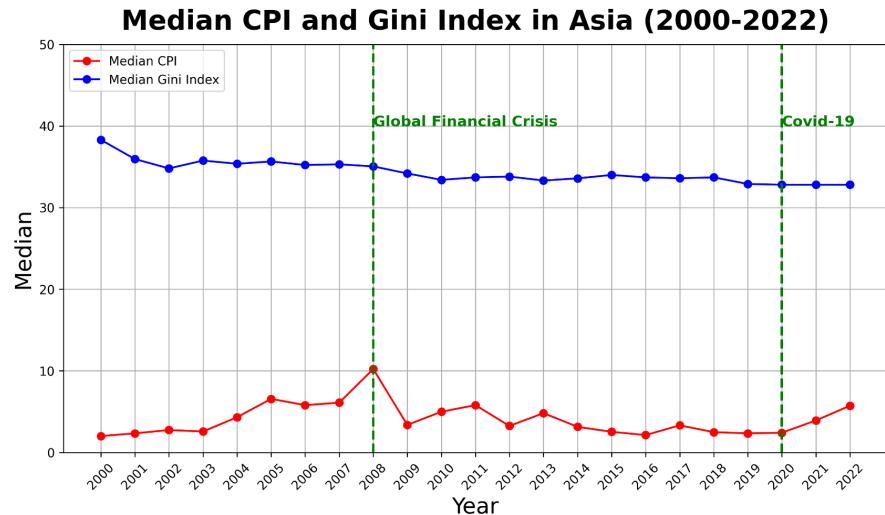


Figure: This line plot compares the median CPI with Gini coefficient for countries in Asia from 2000 to 2022. No clear correlation is evident, however the effect of major global events in 2008 and 2020 can be observed.

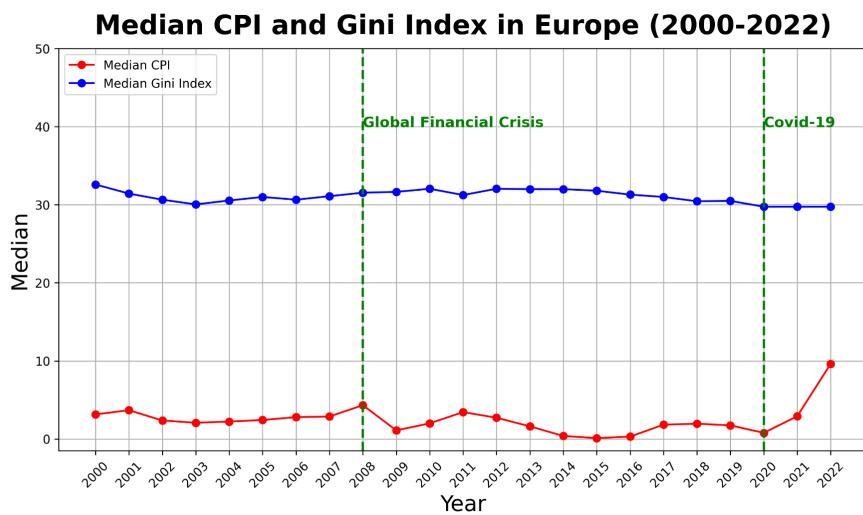


Figure: This line plot compares the median CPI with Gini coefficient for countries in Europe from 2000 to 2022. No clear correlation is evident, however the effect of major global events in 2008 and 2020 can be observed.

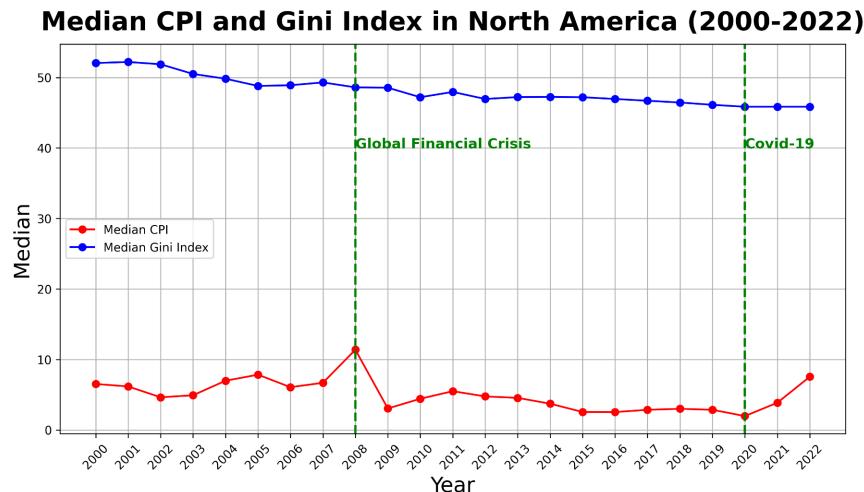


Figure: This line plot compares the median CPI with Gini coefficient for countries in North America from 2000 to 2022.

No clear correlation is evident, however the effect of major global events in 2008 and 2020 can be observed.

Findings and Discussion

Our investigation into the relationship between the Gini Coefficient and CPI across various continents indicates significant differences across continents. Generally speaking, there is no correlation between Gini Coefficient and CPI index. However, some unique patterns can be detected. In terms of regional variations, while there is no clear correlation among the 3 continents that can be observed, the scatter plots show some variations across continents. The CPI index in Asia and Europe stays constant, but the Gini Coefficients change drastically in the past 20 years. Conversely, Gini Coefficients in North America are comparatively stable, while the changes in the CPI index are more significant. Another notable feature is that data points in North America seem to have a trend of clustering, which does not exist in the other two continents. Looking at the impact of Global Events in the line plots, a peak in CPI index can be observed in 2008 and 2020 across all 3 continents. This signifies the Great Recession and the COVID-19 Pandemic. While the Gini Coefficient remains relatively the same during these 2 events, different trends of CPI index are observed. Post-recession there is a significant drop in CPI data. After 2020, CPI rises sharply, especially in Europe.

Possible reasons for a weak correlation include:

- Missing Values in Gini data: Gini coefficient is a difficult index to compute, so that many data are missing. Too much interpolation will influence the accuracy of the analysis.
- Complex Influences on CPI: CPI is a comprehensive index influenced by numerous factors, a multiple factors model is required to understand it more clearly.

Conclusion

In conclusion, our comprehensive analysis of the Consumer Price Index (CPI) and its relationship with key economic indicators - unemployment rates, income inequality, and national Gross Domestic Product (GDP) - reveals a complex and non-uniform pattern across different

continents. This study, encompassing data from 2000 to 2022, highlights the intricacies in understanding the global cost of living. Significantly, we observed that the CPI does not consistently correlate with the unemployment rate, income inequality (measured by the Gini Coefficient), or GDP growth. These findings suggest that relying on a singular economic indicator to predict or understand CPI trends can be misleading. Instead, the CPI, as a measure of the cost of living, is influenced by a multifaceted set of economic factors, varying across different regions. In our regional analysis, Europe consistently exhibited the highest cost of living, while Asia maintained the lowest. This trend underscores the economic diversity and disparity between these continents. Notably, North America displayed a cost of living that generally positioned it between Europe and Asia, though this varied depending on the specific economic conditions of each country within the continent. The absence of a uniform pattern in the relationship between CPI and the examined economic indicators across Europe, Asia, and North America underlines the complexity of global economic dynamics. It is evident that other economic factors, possibly including but not limited to fiscal policies, market stability, and socio-political factors, play significant roles in shaping the cost of living in these regions. In summary, while this analysis provides valuable insights into the global cost of living trends, it also highlights the necessity of considering a broad range of economic indicators for a more comprehensive understanding. The fact that Europe has consistently shown the highest cost of living and Asia the lowest, with North America fluctuating in between, indicates enduring economic trends. However, these trends should be interpreted with caution, acknowledging the diverse economic landscapes and the multiple factors that influence the CPI in different regions.