

571 Process Book

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Overview and Motivation:

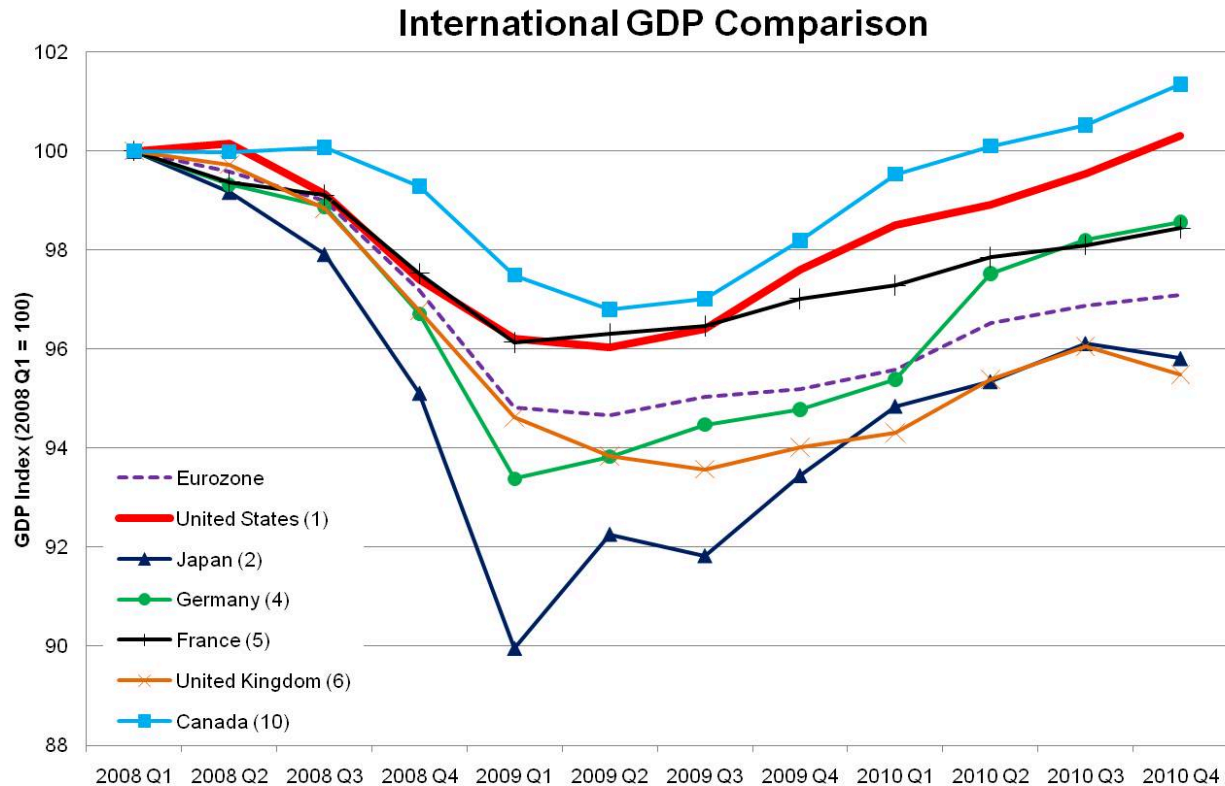
Russia is a country with a long history and complex economic environment. During the Soviet era (1922–1991), it was the core of a vast planned economy that rivaled the United States in military and industrial strength. However, since the mid-20th century, Russia's economic standing has fluctuated significantly.

In the 1950s and 1960s, the Soviet Union maintained a strong industrial base, but inefficiencies in central planning, excessive military spending, and stagnation in innovation hindered long-term growth. The collapse of the Soviet Union in 1991 led to Russia's share of global GDP shrinking sharply as industries collapsed, inflation soared, and state assets were privatized. The early 2000s saw a temporary revival driven by high oil and gas prices, but structural weaknesses, corruption, and geopolitical tensions (such as sanctions after the annexation of Crimea in 2014) have continued to hinder sustainable growth. By the 2020s, Russia's economy had become increasingly dependent on natural resource exports and was further isolated by sanctions following its invasion of Ukraine in 2022.

Many are curious about the strength of Russia in recent years, especially because of the ongoing invasion of Ukraine. Russia's aggressive geopolitical strategy in the 21st century has the world worrying about the state of Russia and the fate of Eastern Europe. It would be good to educate ourselves and others on the strength of Russia as they are making headlines in current geopolitics. Trends in Russia economics certainly inform NATO's response to Russian aggression, so the impact of recent sanctions against Russia should be quantified. Our goal for this project was to create a line graph of Russia's percentage of world GDP along with the United States percentage of world GDP over time. Our hope is that this would give anyone who reads the chart a visual understanding of the strength of the two nations over time, and any trends in percentage of world GDP change will be easily noticeable.

Related Works:

To get an idea of what we wanted our visualization to look like, we searched the web for related visualizations. Below is an example of the type of design we would go for, but this one is only for a short time span.



Questions:

The primary question that we are trying to answer with our visualization is how does the economic strength of Russia compare to the USA and the rest of the world throughout history. Other related questions include: Did Russia rival the U.S. economy during the cold war?. Was Russia's economy stronger during the Soviet Union era or the Russian Federation Era?. How much stronger is the U.S. economy than Russia's? Knowing the answer to these questions will assist in learning the history of Russia and could explain Putin's current foreign policy. This is something that anyone would benefit from, especially those interested in international affairs, as it would contextualize Russia and the U.S.'s place in the global economy. An effective data visualization that answers these questions will be able to communicate these findings in a concise, consumable, and intuitive manner.

Data and Data Processing:

The data we are going to use to answer the questions above are the percentage of global GDP by year for Russia and the U.S. It's impossible to quantify the strength of a country in a single number, but GDP is as good a metric as we have. GDP is the total monetary value of all finished goods and services produced within a country's borders in a specific time period, usually measured quarterly or annually. It's one of the key indicators of economic performance.

Data on the percentage of Global GDP by year isn't readily available in that exact form, but we can calculate it based on data that is able to be found on the internet. The Maddison Project Database has data on many Countries GDP per capita and population by year. With this data we can easily calculate total GDP with this simple equation.

$$TotalGDP = GDP\ per\ capita * population$$

(<https://www.rug.nl/ggdc/historicaldevelopment/maddison/releases/maddison-project-database-2023>)

In our visualization, we are going to be plotting the percentage of global GDP for the U.S. and Russia, so we need data on the global GDP by year as well. This can be found online at [macrotrends.net](https://www.macrotrends.net). With this data we can now calculate percentage of global GDP for a country

$$\% \ of \ global \ GDP = CountryGDP / GlobalGDP$$

<https://www.macrotrends.net/global-metrics/countries/wld/world/gdp-gross-domestic-product#:~:text=World%20gdp%20for%202023%20was.a%202.69%25%20decline%20from%202019>.

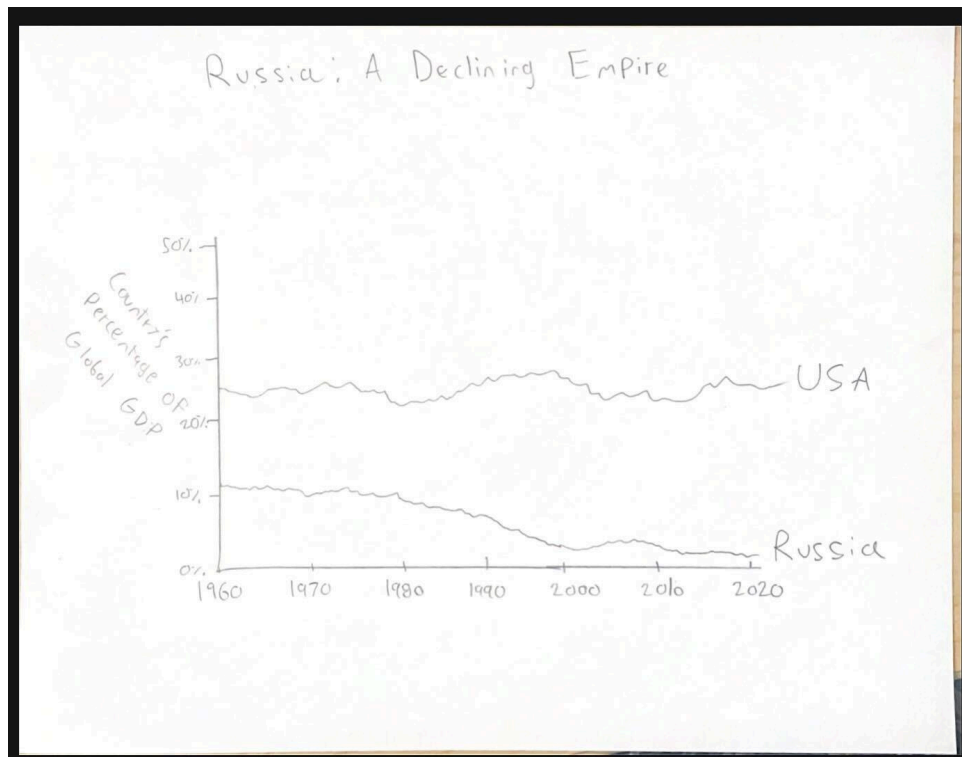
When it came to choosing the time span of our data. We wanted to choose a date that is early enough to give enough historical context to Russia and the U.S. economic history, while still having reliable records for that time period. This was a difficult task because the Soviet Union in particular did not keep good records on their population and GDP. We could have started our line chart in the year 1989, when the Soviet Union collapsed and the Russian Federation succeeded them, but that would undermine the long-term trend that we are hoping shines through in the final line chart.

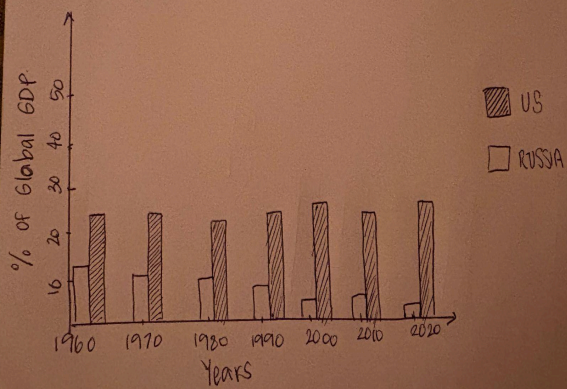
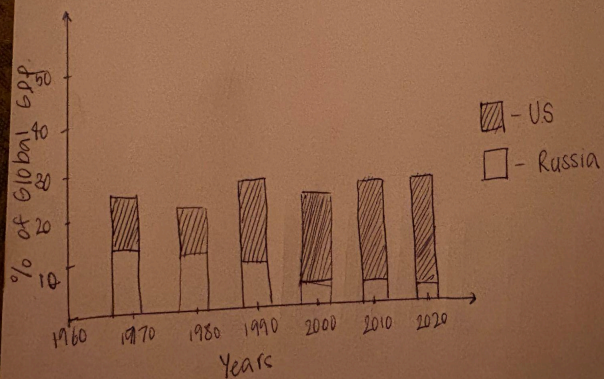
Another roadblock in the data collection process was inflation and currency exchange rates. While GDP data for recent years were readily available in current (2025) US\$, the farther back you try to look, that data is harder to find. For example the Maddison Project has data going back until 1950, but their data is in 2011 U.S dollars, so we had to convert that into 2025 U.S. \$. Different data sets also disagree on exact figures for GDP and population. The discrepancy is minimal for recent years. But we have found major discrepancies between multiple reputable sources. Especially around the time of the Soviet Union collapse. This has made it difficult to choose what data we are going to show on the graph, but we still aim to give a truthful representation of The U.S. and Soviet Union's GDP figures to our best ability.

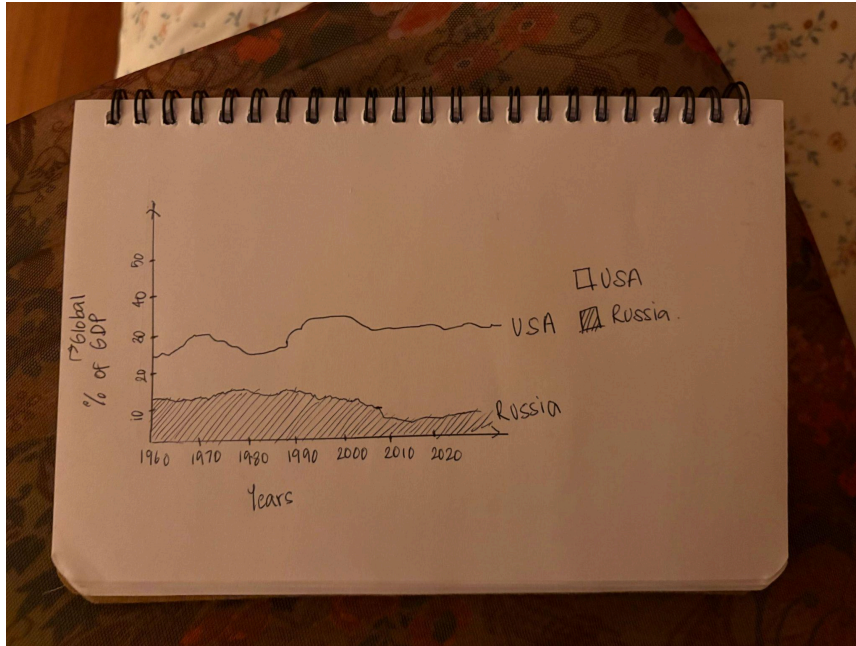
Design Evolution:

Our initial design was to have our data presented in a line chart, but we considered a few different options before deciding that our original idea in the line chart would be most suitable.

Even though the effectiveness principle of data visualization says bar charts are more effective than line charts for categorical data, we have decided to go with the line chart. This is because we have a large amount of categorical data such that there would be too many categories for a line chart. We are going to display GDP data from 1960-2022, which covers 62 years, so that would be too many bars to put on a bar chart. We could group years together in a single bar chart but we felt that would be sacrificing detail. Our data is interesting because it is technically categorical data, but it is ordered and the years are numbers which makes typical quantitative visualization methods useful to us. But most importantly, the change in percent global GDP is most easily seen in a line chart, which is our primary objective.







Implementation and Coding Process

- **Technology Stack:** HTML5, CSS3, JavaScript, and Chart.js v4.
- **Workflow:**
 - We began with a thorough cleaning and preprocessing phase in Excel, where raw GDP per capita, population, and global GDP data were combined and transformed into structured, analysis-ready formats.
 - Metrics such as Total GDP, % of Global GDP, and GDP growth rates were calculated, and anomalous or missing data points were identified and handled through interpolation or exclusion.
 - Cleaned datasets were then manually converted into static JavaScript arrays, facilitating easy integration into the Chart.js library without requiring asynchronous file loading or external database calls.
- **Designing the Visualizations:**
 - Before coding, we sketched rough drafts of our visualizations to determine the most effective way to present each metric. Key priorities included maintaining clear comparative views, ensuring temporal trends were visible, and aligning visual elements consistently across charts.

- We decided on a four-panel dashboard layout, each chart focused on one major economic indicator: % of Global GDP, GDP per Capita, GDP Growth Rate, and Inflation Rate.
- Colors were carefully selected to maximize contrast between the USA (blue), Russia (red), and the World Average (gray), ensuring accessibility for users with visual impairments.
- **Coding the Visualizations:**
 - Each chart was embedded inside its own canvas element, enabling independent updates and responsiveness.
 - Chart.js configurations were heavily customized:
 - Axes were labeled clearly, with readable ticks and rotated labels where necessary.
 - Tooltips were fine-tuned to display exact values and corresponding years.
 - Animated transitions were configured for smoother visual feedback when switching between datasets.
 - Scales were adapted dynamically based on the data range, preventing misleading visual impressions.
 - We added interactive tooltips and hover effects, enhancing user engagement and data exploration without cluttering the charts.
- **Challenges Encountered:**
 - Initial attempts at embedding annotations for major events (e.g., 1991 collapse, 2014 sanctions) were visually overwhelming. We iterated by simplifying these annotations or embedding them directly into tooltips instead of cluttering the charts.
 - Fine-tuning the Y-axis domains proved critical for making sure relative trends were visible even when metric magnitudes varied greatly (e.g., comparing Russia's vs USA's GDP per capita).

Throughout the coding and design process, our focus remained on balancing clarity, aesthetic appeal, and storytelling. By iteratively refining both our data transformations and visual presentation, we ensured that users can quickly grasp the economic narratives behind the numbers