

Report TP | Data Preparation and Visualization

Team 2 | 2025/2026

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Content

1.	Introduction	3
2.	Contextualization	3
3.	Objective	3
4.	Research Questions	4
5.	Data	4
5.1.	Dataset description	4
5.2.	Pre-Processing	5
5.2.1.	Inflation by Category	5
5.2.2.	Average Inflation by Country	5
5.2.3.	Total Inflation Over Time	6
5.2.4.	Ranking of Annual Percentage Change in Inflation by Country	6
6.	Visualization	6
6.1.	Design Choices	8
6.1.1.	Inflation by Category	8
6.1.2.	Average Inflation by Country	8
6.1.3.	Total Inflation Over Time	9
6.1.4.	Ranking of Annual Percentage Change in Inflation by Country	10
6.2.	Insights	11
6.2.1.	Inflation by Category	11
6.2.2.	Average Inflation by Country	12
6.2.3.	Total Inflation Over Time	12
6.2.4.	Ranking of Annual Percentage Change in Inflation by Country	13
7.	Evaluation	13
7.1.	Evaluation Tasks for the Graph Design	13
7.2.	Color Check	15
8.	Limitations of the Tool and Libraries	17
9.	Conclusion	17
10.	References	18

1. Introduction

Data visualization is essential for turning complex data into clear and accessible insights. As data volumes grow, visual representations help reveal patterns, anomalies, and relationships that might remain hidden in raw datasets, while also improving communication and supporting deeper analysis.

It is within this context that this project was developed as part of the *Data Visualization and Preparation* course. The aim of the work is to use visualization techniques to create interactive and meaningful representations of the real-world data, enabling users to explore trends and understand Portugal's position within the European Union (EU) inflation landscape from 2000 to 2024.

2. Contextualization

Inflation is the sustained increase in the general price level of goods and services. It is a headline macroeconomic indicator shaping households' purchasing power and public budgets. In the European Union (especially in the Euro area), tracking inflation is key for a single monetary policy and for judging whether member states are moving together or drifting apart. As so, the European Central Bank aims for low and stable inflation (ideally around 2%), considering that when it stays too high or too low for prolonged periods, relative prices get distorted and growth can suffer.

Since the early 2000s, Europe has been shaped by successive shocks: financial crisis, sovereign-debt turmoil, the pandemic, and the energy and supply-chain disruptions following Russia's invasion of Ukraine. Their impact on inflation varied widely across countries, given differences in exposure and policy responses.

Comparative analysis, therefore, helps clarify how sector-specific pressures (energy, food, housing services, tradable goods) translate into headline inflation, informing national policy mixes on income support, taxation, and structural reforms. In the European context, to make those comparisons consistent, the EU uses the Harmonised Index of Consumer Prices (HICP), which measures inflation in a comparable way across countries and over time.

Understanding how Portugal compares with the European pattern is therefore relevant both for national policy assessment and for situating domestic developments in the common policy framework.

3. Objective

This project's primary objective is to develop interactive visuals that make examining inflation data throughout the EU simple and informative. The project makes it easier for users to quickly grasp trends and patterns by transforming unprocessed inflation data into a visually appealing visualization.

It specifically focuses on:

- Showing variations across important categories of goods and services by comparing Portugal's inflation rates over time with the EU average.
- Mapping inflation at the national level makes it simple to identify outliers by revealing regional trends and extremes.

- Displaying general inflation trends over time with comments for significant economic occurrences, including the COVID-19 epidemic, banking crisis, and the conflict between Russia and Ukraine.
- Portugal's relative position in the EU can be understood by ranking nations according to inflation each year.

Together, these visualizations seek to strike a balance between clarity and detail, providing the public, scholars, and policymakers with an approachable means of seeing patterns, drawing comparisons, and assisting with well-informed economic decisions.

4. Research Questions

The visualizations in this project aim to address the following research questions:

1. **How does Portugal's inflation vary across different categories of goods and services compared to the EU average in a selected year?**
2. **How does Portugal's overall inflation compare to the EU countries with the highest and lowest inflation in each year?**
3. **How has Portugal's total inflation evolved from 2000 to 2024, and how does it compare to the EU average across years, especially during major economic events?**
4. **How does Portugal rank among EU countries in terms of annual inflation, particularly compared to the countries with the highest inflation each year?**

5. Data

This section describes the inflation dataset used in the project, including its structure and key attributes.

The pre-processing steps applied ensure that the data is clean, consistent, and properly structured with a particular focus on Portugal. This allows for accurate comparisons between Portugal and other EU countries, as well as meaningful insights into trends across categories and time.

5.1. Dataset description

The analysis relies on a single source from PORDATA: *Inflation rate (%) by goods and services (Portugal in Europe)*. The file contains 10 179 rows and 8 columns, covering annual observations for European countries. Each record corresponds to a unique *[year × country × consumption category]* combination and reports the annual average rate of change in the Harmonised Index of Consumer Prices (HICP), expressed in percent.

Variables included in the CSV file:

- '**01. Ano**' - year (integer);
- '**02. Nome País (Europa)**' - country name (text);
- '**03. Filtro 1**' - consumption category (text);

- ‘**08. Valor**’ - inflation rate (numeric, %);
- ‘**04. Filtro 2**’, ‘**05. Filtro 3**’, ‘**06. Escala**’, ‘**07. Símbolo**’ - auxiliary metadata fields that appear sparsely and are not required for analysis.

Categories include a **Total** aggregate alongside 12 detailed groups (e.g., food, transport, housing, health). Values can be negative (deflationary episodes) as well as positive.

The panel spans 27 European countries (EU members over the period) from 1996–2024, enabling cross-country and over-time comparability at both the headline **Total** and category levels.

Completeness and quality: After a first analysis, the working variables (Year, Country, Category, Value) contain no missing values. From 2000 onward, the dataset is balanced: all 27 countries report observations every year for **Total** and each of the 12 categories. This guarantees full cross-country and over-time comparability for the analysis period without imputation.

File notes: The CSV export contains non-observational lines (e.g., update notes and source strings) at the end of the file. These are easily identified and removed during basic data cleaning.

5.2. Pre-Processing

For all visualizations, the data was first pre-processed by selecting only the relevant columns and ensuring each variable had the correct type (e.g., numeric for year). Additionally, only records from 2000 onwards were retained to focus the analysis on recent trends.

5.2.1. Inflation by Category

For the visualization comparing inflation in Portugal with the European Union average across different categories, the data was prepared to highlight category-specific differences. The preprocessing focused on choosing pertinent categories, translating labels for clarity, calculating averages, and rearranging the dataset for simple comparison.

The following steps were performed to prepare the data for this visualization:

- Removed the **Total** category to retain only particular product and service categories.
- Portuguese category titles were translated into English to make them easier to read.
- Determined the average annual and category inflation in the European Union.
- Separated the data from Portugal and combined it with the average for the European Union.
- To plot the data, it was converted to a long format with columns for inflation and region.
- Selected main categories for visualization: **Housing**, **Water**, **Electricity**, **Gas & Other Fuels**, **Clothing & Footwear**, **Food & Non-Alcoholic Beverages**, **Health**, and **Transport**.
- Aggregated inflation values by year, region, and category.
- Created a new column indicating the sign of inflation (positive or negative) and combined it with the region for color mapping in the plot.

5.2.2. Average Inflation by Country

For the geographical view, the data was prepared to show the total inflation across European Union countries, allowing a geographical comparison and easy identification of regional patterns.

The following steps were performed to prepare the data for this visualization:

- Filtered the dataset to keep only the **Total** inflation values, removing category detail.
- Selected only the relevant columns: **Year**, **Country**, and **Inflation**.

- Loaded a spatial map of Europe using the `rnatuelearth` package, keeping all European countries.
- Translated country names from Portuguese to English to ensure consistency with the map data.

5.2.3. Total Inflation Over Time

For the total inflation visualization, the data was prepared to show the evolution of Portugal's inflation from 2000 to 2024 and compare it with the EU average, allowing a clear temporal analysis and highlighting relevant economic events.

The following steps were performed to prepare the data for this visualization:

- Filtered the dataset to keep only records with the `Total` category.
- Selected the relevant columns: `Year`, `Country`, and `Value` (inflation).
- Calculated the EU average annual inflation and combined it with Portugal's data.
- Converted to long format for plotting with `Region` and `Inflation` columns.
- Added label adjustments for clarity when values were close.
- Annotated major economic events: *Global Inflation Crisis*, *Troika & Austerity*, *COVID-19*, and *Russia-Ukraine war*.

5.2.4. Ranking of Annual Percentage Change in Inflation by Country

For the rank visualization, the data was prepared to position each country within its year's inflation distribution, enabling a year-by-year comparison of Portugal against the other EU member states.

The following steps were performed to prepare the data for this visualization:

- Filtered records to only retain the `Total` category, removing category detail.
- Selected the relevant columns: `Year`, `Country`, and `Value` (inflation).
- Calculated the rank for each year, ordering countries by their total inflation, from highest (*1st*) to lowest (*27th*). Countries with identical inflation share the same rank.

6. Visualization

This visualization provides a comprehensive view of inflation trends in Portugal, comparing them with the European Union (EU) countries from 2000 to 2024. It includes:

- **Inflation by Category** (Animated Bar Chart): Shows annual inflation by key consumer categories in Portugal alongside the EU average. Users can explore how inflation evolves year by year. Positive and negative values are visually distinguished to highlight periods of price increases or decreases.
- **Average Inflation by Country** (Animated Choropleth): Displays total inflation across EU countries, highlighting Portugal's position relative to the highest and lowest rates. The map updates with the selected year, allowing dynamic observation of geographic inflation patterns over time.
- **Total Inflation Over Time** (Connected Dot Plot): Presents Portugal's total inflation and the EU average for each year as points connected by segments. This visualization emphasizes major economic events such as the Global Financial Crisis, Troika & Austerity, the COVID-19 pandemic, and the start of the Russia-Ukraine war.

- **Ranking of Annual Percentage Change in Inflation by Country (Rank Plot):** Ranks EU countries annually by inflation rate. Portugal is always highlighted with a distinct color, while additional countries can be selected for comparison. This allows users to track both Portugal and other countries of interest over time.

The dashboard combines interactive elements for year selection (available in the first two visualizations), clear color-coding, and intuitive layouts to deliver actionable insights into inflation dynamics in Portugal and across the European Union.

The visualization is presented below:

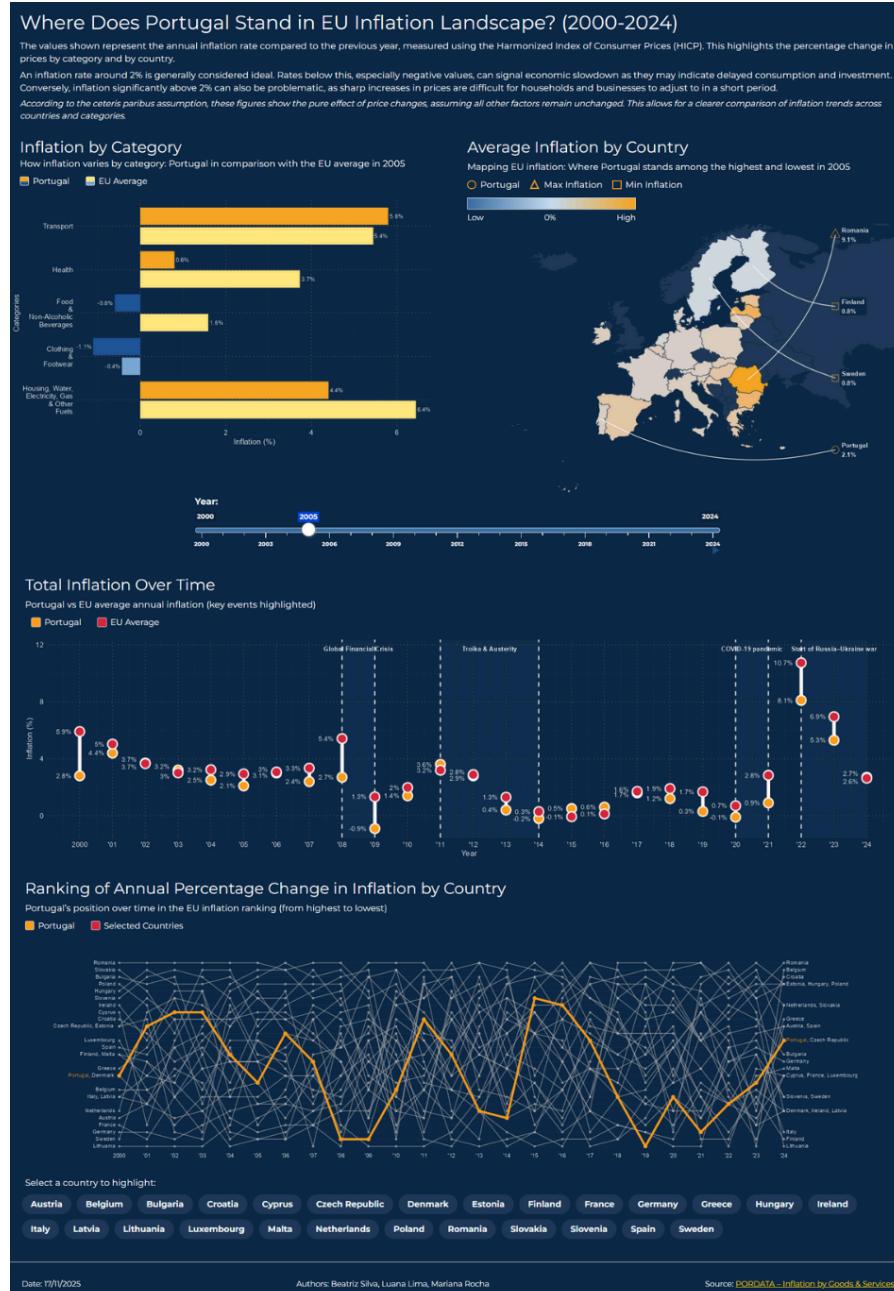


Figure 1: Final Visualization

Although the image shown here is static, the full interactive dashboard has been deployed online. The web application allows dynamic exploration of inflation trends by country and year. The live dashboard is accessible at <https://mariana-rc01.shinyapps.io/EuroBoom/>.

6.1. Design Choices

The visualizations were designed to address the research questions clearly, highlighting key trends and differences while guiding attention to the most relevant categories and periods.

6.1.1. Inflation by Category

The category-based visualization was designed to provide a clear, intuitive comparison between Portugal and the European Union average across categories for a given year. Several design decisions were implemented to support this objective:

- **Bar Chart Structure (Horizontal Bars):**
 - A horizontal bar chart was selected to accommodate long category names and improve readability.
 - Grouped bars (Portugal vs EU average) enable direct side-by-side comparison within each category.
- **Color Encoding:**
 - Four distinct colors were chosen to represent Portugal and the EU average for positive and negative inflation separately:
 - Portugal with positive average: Orange tone
 - Portugal with a negative average: Blue tone
 - EU with positive average: Lighter orange tone
 - EU with negative average: Lighter blue tone
 - This color scheme allows a clear visual distinction between Portugal and the EU average, while also immediately showing whether inflation is positive or negative.
- **Dynamic Year Selection:**
 - The plot updates interactively based on the selected year, allowing users to explore how inflation patterns vary across categories over time.
 - This dynamic interaction is exclusive to this visualization and the Average Inflation by Country plot, providing temporal flexibility where most meaningful.
- **Value Labels on Bars:**
 - Each bar includes a white numeric label showing the exact inflation rate, improving precision without forcing users to read values from the axis.
 - The label placement shifts depending on whether inflation is positive or negative, preserving clarity.
- **Axis and Layout Choices:**
 - Category labels are split across multiple lines for readability, preventing text overlap.
 - The flipped coordinate system (categories on the y-axis) supports legibility in narrow spaces.
- **Selected Categories Focus:**
 - Only the most economically relevant categories were included. This filters out less relevant data, directing focus to the sectors that have the greatest impact on consumers.

6.1.2. Average Inflation by Country

The visualization shows Portugal's overall inflation in the context of the European Union each year. It highlights the countries with the highest and lowest inflation and positions Portugal

relative to these extremes, enabling users to quickly compare across countries. Key design elements were implemented to support this aim:

- **Choropleth Map Structure:**
 - EU countries are colored according to their inflation rate, using a diverging scale from blue (low) to white (neutral) to orange (high).
- **Highlighting Key Countries:**
 - Portugal, the country with maximum inflation, and the country with minimum inflation, are emphasized with distinct shapes and outlines for immediate recognition.
- **External Labels and Connectors:**
 - Key country names and exact inflation values are positioned outside the map and connected via curved lines to reduce clutter and improve readability.
- **Dynamic Year Selection:**
 - The map updates interactively based on the selected year, allowing exploration of temporal changes.
- **Legends and Layout:**
 - A gradient legend shows low-to-high inflation, and marker shapes clarify Portugal, the maximum, and minimum inflation values.

6.1.3. Total Inflation Over Time

The visualization was designed to clearly communicate the evolution of Portugal's inflation relative to the EU average over the period 2000-2024. Each design element was chosen to highlight trends, differences, and important economic events:

- **Points(Circles):**
 - Annual inflation values for Portugal and the EU average are represented by distinct color points.
 - Portugal is highlighted with orange and the EU average with red, making them easily distinguishable against the background. These colors were chosen to differ from those used in the previous category plots, where gradients indicated positive and negative inflation.
- **Segments Connection Points:**
 - White vertical segments connect Portugal's point to the EU average for each year, visually emphasizing the magnitude of the difference and enhancing visibility against the dark background by incorporating the two points.
- **Annotations and Bands:**
 - Semi-transparent bands and dashed vertical lines indicate major economic events.
 - Labels at the top of each band inform the viewer about these events, providing contextual understanding of inflation fluctuations.
- **Labels:**
 - Each point includes a label with its exact inflation value, making the data clear and readable.
- **Axes:**
 - Years are represented on the x-axis, starting from 2000, with subsequent years abbreviated as '01, '02, '03, etc., to save space.

- ▶ Inflation values are represented on the y-axis, allowing direct comparison between Portugal and the EU average.

6.1.4. Ranking of Annual Percentage Change in Inflation by Country

The rank plot was designed to show Portugal's relative position within the EU each year while preserving the full country context. Some design decisions were explored to support this objective:

- **Bump chart over time:**
 - ▶ A time-based bump chart ranks countries by annual inflation, with years on the x-axis and ranks on the y-axis, with 1 at the top (highest inflation).
- **Points, lines, and legibility:**
 - ▶ Small points are drawn at each year to anchor values and improve readability on dense segments.
 - ▶ Subtle dotted horizontal guides mark rank rows to help the eye track vertical movement.
- **Focus and color encoding:**
 - ▶ Portugal is persistently highlighted with a thicker orange line and points, while any user-selected countries appear in red.
 - ▶ All other series are rendered in low-contrast grey, ensuring the highlights stand out on the dark background while the full distribution remains visible, retaining context without dominating the view.
 - ▶ The color palette (orange for Portugal, red for selections, grey for context) is consistent with the dashboard and provides high contrast against the navy background.
- **Labels and axis:**
 - ▶ Country labels are placed outside the plotting area at the first and last year only, connected implicitly by the lines.
 - ▶ Labels dynamically color Portugal and any selected countries within the text, improving scalability and avoiding interior label clutter.
 - ▶ Years are represented on the x-axis, starting from 2000, with subsequent years abbreviated as '01, '02, '03, etc., to save space and maintain consistency across the different plots.
 - ▶ The y-axis represents ranks only (no country names), keeping the focus on movement rather than numeric values.
- **Interaction:**
 - ▶ Buttons allow users to toggle countries for comparison, as the plot updates to highlight the chosen series while preserving the full grey context.
- **Alternative considered:**
 - ▶ A stacked “one-year” ranking synchronized with the existing year slider (used for the map and categories) was prototyped. It offered a very clear snapshot for the selected year and simpler visual decoding.
 - ▶ **Why it was not adopted:** it removed temporal context, made country tracking across years difficult, and introduced visual noise as the whole order reshuffled on every year change (while other views also updated).
 - ▶ **Final choice:** the multi-year bump chart preserves continuity, enables quick country comparisons, and lets Portugal's trajectory be traced directly with minimal clutter.

6.2. Insights

This section analyses Portugal's inflation, comparing sector-specific trends and overall country-level patterns with the European Union. Insights highlight key drivers, periods of volatility, and structural patterns affecting consumer costs and price stability.

6.2.1. Inflation by Category

The visualization by category provides a detailed view of how Portugal's inflation compares with the European Union average across key sectors, highlighting both convergences and divergences:

- **Transport:**
 - Transport inflation in Portugal frequently deviates strongly from the EU average, reflecting sensitivity to oil prices, taxation policies, and domestic cost factors.
 - Peaks in 2011 (**9%**) and 2002–2006 (around **4.8–5.6%**) highlight periods when Portugal faced disproportionately high mobility costs relative to the EU average.
- **Housing, Water, Electricity, Gas & Other Fuels:**
 - Portugal's housing and energy inflation generally follows EU trends but remains slightly lower in several periods, such as 2008 (**4% vs 8.96%**).
 - Lower rates suggest that domestic regulation or market conditions may have buffered households from extreme energy price shocks across the European Union.
- **Health:**
 - Health inflation shows sporadic spikes, most notably in 2007 (**7.4% vs 3.21%**) and 2011 (**4.5% vs 2.44%**).
 - These spikes indicate domestic factors (e.g., healthcare reforms, insurance adjustments) drive temporary inflation, independent of EU averages.
- **Clothing & Footwear:**
 - Instances of negative inflation (2004–2005: **−1.1%**) suggest price reductions or weak domestic demand, contrasting with generally neutral EU trends.
 - This sector is highly sensitive to domestic consumption behavior and seasonal pricing strategies, indicating that economic factors specific to Portugal outweigh broader EU patterns.
- **Food & Non-Alcoholic Beverages:**
 - Food inflation often lags behind EU trends, e.g., 2000 (**2.1% vs 4.2%**) and 2019 (**0.3% vs 2.21%**).
 - Food costs exert less volatility on household budgets than other sectors, but prolonged low inflation could mask underlying structural issues in agricultural pricing or supply resilience.

Portugal's inflation profile varies substantially by sector. Transport and Health are the main contributors to deviations from EU averages, affecting consumer spending more than overall inflation figures suggest. In contrast, Housing, Food, and Clothing generally show moderated inflation, reflecting domestic stabilizing mechanisms or slower transmission of costs from EU markets.

Economic shocks, such as energy price hikes or healthcare reforms, tend to impact specific sectors more than the overall inflation rate, highlighting the importance of sector-level analysis.

Recognizing these sector-specific trends is important for policymakers and analysts. Measures to reduce consumer pressure should focus on Transport and Health, while monitoring Housing and Food, for structural changes will ensure more targeted and effective interventions.

6.2.2. Average Inflation by Country

The visualization presents Portugal's overall inflation relative to other EU countries, highlighting the extremes and positioning Portugal within this spectrum each year. The design choices allow quick assessment of temporal trends and country comparisons:

- **Portugal's Position Relative to EU Extremes:**
 - Across most years, Portugal's inflation remains closer to the EU median rather than the maximum or minimum values. For instance, in **2000**, Portugal's inflation was **2.8%**, well below Romania's peak of **45.7%** but above Lithuania's low of **1.1%**.
 - During periods of overall European stability (e.g., 2013–2017), Portugal's inflation was low, often below 2%, reflecting modest domestic price growth compared to more unstable countries.
 - Notably, in **2019**, Portugal recorded the minimum inflation in the EU (**0.3%**), a rare instance where it aligned with the lowest values in Europe.
- **High Inflation Episodes in Europe:**
 - Certain countries, particularly Romania, Hungary, and Estonia, frequently experienced peak inflation, demonstrating episodic shocks in Eastern and Northern Europe.
 - Portugal's inflation remained comparatively moderate during these spikes, suggesting insulation from regional volatility.
- **Recent High Inflation Periods:**
 - The Russia-Ukraine war and global supply disruptions in 2022–2023 caused a substantial rise in inflation across Europe. Portugal's inflation reached **8.1% in 2022** and **5.3% in 2023**, highlighting significant domestic pressure while remaining below peak levels observed in Estonia (19.4%) and Hungary (17%).
 - By **2024**, inflation in Portugal normalized to **2.7%**, returning closer to pre-crisis levels.
- **Temporal Trends:**
 - Portugal's position relative to EU extremes underscores both stability and vulnerability. The country generally avoids the highest inflation spikes but is not immune to continental shocks.

Portugal exhibits a moderate inflation trajectory compared with the EU average and extremes. The country experiences occasional periods of very low or high inflation, but generally maintains a middle-ground position. Monitoring relative inflation across EU countries provides critical context for evaluating domestic price stability, assessing exposure to regional shocks, and guiding policy interventions aimed at stabilizing consumer costs.

6.2.3. Total Inflation Over Time

Portugal vs. EU Average:

Overall, Portugal follows trends similar to the EU average, but with some notable deviations.

- Portugal's inflation was consistently below the EU average, except briefly at the beginning of the Troika period, when it 2012 matched the EU.

- During 2011-2014, both Portugal and the EU had inflation below **2%** (the ideal target), with Portugal reaching **-0.2%**. This indicates an economic lag, which can be harmful.
- In 2015 and 2016, Portugal's inflation slightly exceeded the EU average, though still remaining below **1%**.
- Until the pandemic, Portugal showed a slight delay in keeping pace with EU trends. Both Portugal and the EU were recovering, but the COVID-19 pandemic caused stagnation again.
- Following this, the Russia-Ukraine war caused a sharp increase in inflation:
 - **2022:** EU: **10.7%**, Portugal: **8.1%**
- Such fast increases are problematic, forcing sudden adjustments in spending habits and consumption.

Recent Trends and Normalization

- Despite the high inflation in 2022, there has been a gradual decline in recent years.
- **2024:** EU: **2.7%**, Portugal: **2.6%**
- These values are approaching the ideal and expected target for inflation.

6.2.4. Ranking of Annual Percentage Change in Inflation by Country

The rank view places Portugal within the EU distribution each year (1st in rank for highest inflation). Some patterns stand out:

- **Mostly mid-to-lower ranks:** Portugal spends much of the period in the middle or lower half of the table, indicating comparatively moderate inflation relative to other EU countries.
- **Episodes at the bottom (very low inflation):** Notable dips occur around 2008–2009 and again in 2019, when Portugal sits near the last positions (lowest inflation in the EU).
- **Short spells of higher relative inflation:** Temporary climbs into the upper half appear around 2002–2003, 2006, and 2011–2012, with a renewed move upward by 2024, but these peaks are brief and do not persist.

Since the plot allows highlighting other countries, it is possible to have a more granular view of Portugal against, for example, two relevant profiles: a large euro-area core economy (Germany) as a stability anchor and a close Iberian neighbor with similar exposure and policy regime (Spain):

- **Portugal vs Germany:** Germany typically sits below Portugal in the ranking (lower inflation) with smaller swings. During 2021–2023, Germany rises but not as sharply as other countries, reinforcing Portugal's position as moderately higher than Germany in several years, yet still within a relatively stable band.
- **Portugal vs Spain:** Spain's path broadly parallels Portugal's but with marginally higher peaks in several episodes, placing Spain above Portugal more often in those years. By 2024, both move back toward mid-table, signalling Iberian convergence after the energy spike.

7. Evaluation

7.1. Evaluation Tasks for the Graph Design

To assess the clarity and effectiveness of the four visualizations created, a series of simple interpretation tasks was defined. These tasks aim to measure how easily a viewer, without prior involvement in the creation, can extract key information.

Because an ideal design process would involve iterative testing with external users (prototype → feedback → redesign → retest), this was not fully feasible in the academic context. Instead, intermediate refinements were carried out internally by the group during development. Now that the final versions of the visualizations are complete, the evaluation focuses on external participants from three possible backgrounds:

- Economics
- Data Science
- Non-specialist (no prior experience in either field)

Each participant is asked to look at the graphs and perform specific tasks. No additional explanation is provided beyond the visual information. Participants are scored according to the following scale:

- 1: Unable to perform the task
- 2: Able to perform the task, but with delay or requiring help
- 3: Able to perform the task easily and without assistance

The tasks defined for each graph are presented below.

- **Inflation by Category**

1. Identify which regions are being compared (Portugal and EU).
2. Identify the year currently displayed using the slider.
3. Read Portugal's inflation value for a given category.
4. Determine whether Portugal's inflation in a given category is positive or negative.
5. Assess whether the labels on the bars are clear and easy to read.

- **Average Inflation by Country**

1. Identify Portugal on the map.
2. Identify the country with the highest inflation in the selected year.
3. Identify the country with the lowest inflation in the selected year.
4. Assess whether the color scale is intuitive and easy to interpret.
5. Read Portugal's inflation value directly from the map.

- **Total Inflation Over Time**

1. Identify the two series shown in the plot (Portugal and EU).
2. Find Portugal's inflation value in a specific year.
3. Find the EU average inflation value in a specific year.
4. Identify the year with the largest gap between Portugal and the EU.
5. Identify at least one major economic event annotated on the graph.

- **Ranking of Annual Percentage Change**

1. Highlight a country using the buttons and confirm that it becomes clearly visible.
2. Identify the top-ranked country in the final year.
3. Locate Portugal on the rank.
4. Compare Portugal's rank with one other selected in a given year.
5. Identify the trend of Portugal's rank over the last five years.

To collect feedback and evaluate the clarity and effectiveness of our visualizations, we created a Google Form for participants to complete the tasks described above. The form allows participants to provide their responses directly, enabling us to measure how easily users can extract key information from the visualizations. It is possible to access and respond to the form at the following link: <https://docs.google.com/forms/d/e/1FAIpQLSdMQjeiUH6c-BacMp16goBNqCdKkC8kP6ILSBQ8bBjciGQQ/viewform?usp=header>.

Below is a preview of the Google Form interface:

Evaluation of EuroBoom Visualization

Thank you for taking the time to participate in this short survey. This questionnaire is part of a project developed for the *Data Visualization and Preparation* course, where we created an interactive dashboard to explore inflation trends in Portugal and across the European Union from 2000 to 2024. The goal of this survey is to evaluate how clear and intuitive the visualisation is for different users.

You can access the interactive dashboard here: <https://mariana-rc01.shinyapps.io/EuroBoom/>.

Please view the visualisation before answering the questions.

Your responses are anonymous and will help us assess the effectiveness of the design and identify potential improvements.

Thank you very much for your time and collaboration!

[Inicie sessão no Google para guardar o seu progresso. Saiba mais](#)

* Indica uma pergunta obrigatória

Do you have experience in any of the following fields? *

Economics
 Data Science
 No experience in these fields

Inflation by Category *

	Unable to perform the task	Able to perform the task, but with delay or requiring help	Able to perform the task easily and without assistance
Identify which regions are being compared (Portugal and EU).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Identify the year currently displayed using the slider.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Read Portugal's inflation value for a given category.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Determine whether Portugal's inflation in a given category is positive or negative.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Assess whether the labels on the bars are clear and easy to read.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Average Inflation by Country *

	Unable to perform the task	Able to perform the task, but with delay or requiring help	Able to perform the task easily and without assistance
Identify Portugal on the map.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Identify the country with the highest inflation in the selected year.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Identify the country with the lowest inflation in the selected year.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Assess whether the color scale is intuitive and easy to interpret.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Read Portugal's inflation value directly from the map.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Total Inflation Over Time *

	Unable to perform the task	Able to perform the task, but with delay or requiring help	Able to perform the task easily and without assistance
Identify the two series shown in the plot (Portugal and EU).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Find Portugal's inflation value in a specific year.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Find the EU average inflation value in a specific year.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Identify the year with the largest gap between Portugal and the EU.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Identify at least one major economic event annotated on the graph.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Ranking of Annual Percentage Change *

	Unable to perform the task	Able to perform the task, but with delay or requiring help	Able to perform the task easily and without assistance
Highlight a country using the buttons and confirm that it becomes clearly visible.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Identify the top-ranked country in the final year.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Locate Portugal on the rank.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Compare Portugal's rank with one other selected in a given year.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Identify the trend of Portugal's rank over the last five years.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Enviar **Limpar formulário**

Figure 2: Screenshots of the Google Forms used for the evaluation tasks

The evaluation results from the Google Form are summarized in the table below, showing participants' scores for each task across the four visualizations.

	Inflation by Category					Average Inflation by Country					Total Inflation Over Time					Ranking of Annual Percentage Change				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Economics	P1	3	3	3	2	3	3	2	3	2	2	2	2	3	3	3	3	3	3	3
	P2	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Data Science	P3	2	3	3	2	3	3	2	2	3	2	3	3	3	3	3	3	3	3	3
	P4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Non-specialist	P5	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	2	3	3	3
	P6	3	3	3	3	3	3	3	2	3	3	3	3	3	2	3	3	3	3	3

Figure 3: Table showing participants' scores for each task

Overall, the results indicate strong performance across all tasks. Most participants scored 3 on the majority of tasks, suggesting that the visualizations are clear, intuitive, and accessible even for those without prior experience in economics or data analysis. Some minor difficulties were observed in reading exact values from the “Average Inflation by Country” map and identifying subtle differences in the “Total Inflation Over Time” plot, particularly for non-specialist participants.

7.2. Color Check

To verify that the visual encoding remains legible under common forms of color-vision deficiency, the dashboard was tested with simulated views for deutanopia, protanopia, tritanopia, and a desaturated variant (Fig.4). The check focused on the three core palettes used across views:

- the paired bars in the category chart;

- the blue–white–yellow diverging scale on the map;
- Portugal (orange) vs. selected countries (red) vs. context (grey) in the rank plot.

Findings:

- In the category bars, the Portugal and EU pairing remains separable (different hues and lightness).
- The blue–white–yellow choropleth stays interpretable under deutanope/protanope/tritanopia: blue tones remain distinct from warm tones, while white as midpoint preserves a clear neutral anchor.
- The orange and red highlight scheme remains distinguishable across different modes due to luminance contrast and stroke thickness, and context lines in low-contrast grey recede as intended without disappearing.
- Point markers and text use white outlines/labels to maintain readability on the dark background across all simulations.

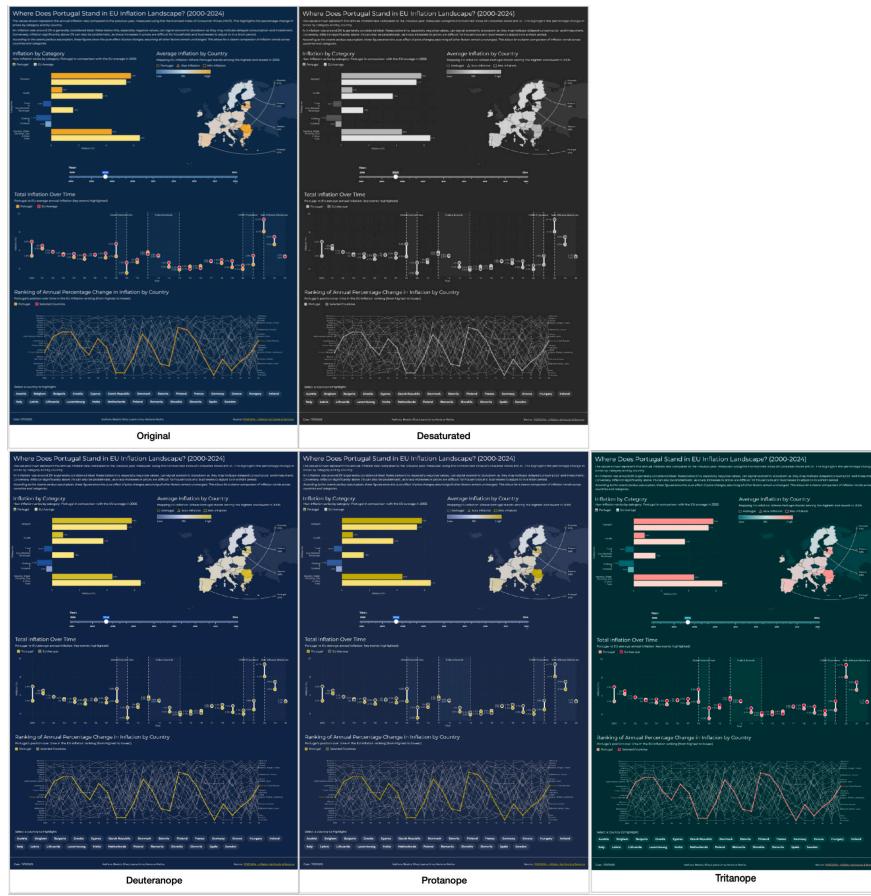


Figure 4: Colorblind safety check

8. Limitations of the Tool and Libraries

While the visualizations successfully communicate key trends and comparisons, the tools and libraries used imposed some constraints on interactivity and dynamic features. The project relied primarily on `ggplot2`, `shiny`, `tidyverse`, `sf`, `rnatgeospatial`, `rnatgeodata`, `ggttext`, and `stringr`. These are powerful for data manipulation and plotting, but have certain limitations for highly interactive dashboards:

- **Rank plot interactivity:** It is not possible to click on a line to highlight it dynamically; users can only select countries through pre-defined buttons.
- **Map tooltips:** Hovering over a country does not automatically display its exact inflation value; users must rely on the color gradient, which can make reading precise numbers difficult.
- **Year slider responsiveness:** Updates when moving the year slider are slightly delayed, especially when animating through multiple years quickly.

These limitations meant that we had to simplify some interactive features and encode information more statically. While the visualizations remain clear and informative, further improvements would require libraries or frameworks with more advanced interactivity options, such as `plotly`.

9. Conclusion

The analysis of Portugal's inflation from 2000 to 2024, in comparison with the European Union, reveals a clear picture of domestic price changes. Portugal generally maintains moderate inflation, avoiding the highest peaks seen in other EU countries, though some categories, especially Transport and Health, show strong deviations from EU averages.

Inflation varies across categories: Transport and Health are the main drivers of difference, while Housing, Food, and Clothing are more stable, reflecting domestic mechanisms or slower cost transmission from EU markets. This shows that understanding category-specific trends is important for designing effective measures to reduce pressure on households.

At the country level, Portugal's inflation generally stays close to the EU average, reflecting steady domestic price growth. Sudden spikes during events like the COVID-19 pandemic and the Russia-Ukraine war reveal that external crises can still have significant local effects.

Meanwhile, ranking and geographical visualizations highlight Portugal's position among EU countries, showing how it compares with both high- and low-inflation nations. These views help identify relative strengths and vulnerabilities, providing a broader perspective on how domestic inflation fits within the European context.

Overall, combining category-specific insights with country-level and temporal analyses provides a comprehensive understanding of Portugal's inflation dynamics. This combined analysis enables policymakers, analysts, and the public to understand the factors behind price changes and Portugal's standing within the EU, guiding informed actions to preserve price stability and safeguard household purchasing power.

10. References

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