COM-480 - Data Visualisation
Process Book

Visualizing Swiss Trade

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1 Overview

The Swiss Trade Visualizer is an interactive data visualization platform that provides insights into Switzerland's import and export activities from 1988 to the present. Designed as a final project for the COM-480 Data Visualization course at EPFL, the application was developed by a team of two and a half students. The central aim of the project was to help users—from policymakers to researchers and the general public—understand how Switzerland's trade relationships and product categories have evolved over time, through a clean and engaging user interface that prioritizes both exploration and clarity. This process book first goes into a quick overview and then goes deeper into some example of our path with sketches and experience.

The project began with brainstorming sessions where we identified potential themes that would offer both depth and narrative potential. We settled on the topic of Swiss imports and exports due to the availability of rich, historical datasets on opendata.swiss, and because trade is a powerful lens through which to examine economic relationships and trends. Our first milestone consisted of defining our goal and check the feasibility. The second milestone is used to find the path to the final project with conceptual sketches outlining the user interface, including a landing page, interactive maps, and charts.

The Swiss customs dataset is vast and complex, containing millions of entries across multiple years, countries, and tariff categories. We encountered challenges in harmonizing the data. Using Python, we cleaned and restructured the dataset into a more usable format every time needed. We use *.json* files to map the ids and the actual name of each category and country.

With the dataset prepared, we transitioned to designing the visual interface. We started with low-fidelity wireframes that emphasized key user journeys: exploring overall trade trends, drilling down into product categories, and comparing trade flows by country. The designs evolved based on friends feedback and our skills limitations.

The implementation phase centered around D3.js for data-driven visuals, with the site built using JavaScript, HTML, and CSS. Our core visualizations included an interactive world map to visualize trade volumes geographically, stacked area charts to show temporal trends, and bar charts for product comparisons. We added filtering mechanisms for year, country, and tariff categories to enable more granular exploration. Early development hurdles included handling asynchronous data loading. Through iterative debugging and optimization, we were able to build a responsive and engaging frontend that met our initial design goals.

We conducted usability tests with friends, which revealed problems with navigability and tooltip readability. Based on this feedback, we enhanced the tooltip design, added better explanatory legends, and improved the clarity of interaction prompts. The final product was deployed using GitHub Pages, chosen for its ease of use and integration with our version control workflow on GitHub.

2 Challenges and Key Design Decisions

Working with a time series dataset spanning over 30 years and covering multiple dimensions presented significant technical and design challenges. One of the primary technical hurdles was ensuring smooth performance while enabling users to access detailed, granular information. To address this, we opted to preprocess the data in advance as much as possible and avoid computationally expensive real-time aggregation within the browser.

Another key challenge was determining the appropriate amount of information to display at any given moment. Striking a balance between informativeness and simplicity was essential to prevent user overload. We adopted a progressive disclosure design strategy: users begin with high-level overviews and can progressively explore more detailed views based on interest.

Maintaining visual and functional consistency across the application was also a central design consideration. The visual identity of the Swiss Trade Visualizer is built around principles of minimalism and clarity. We chose a neutral background to let data colors stand out, avoiding decorative or distracting elements. The primary color palette—white, grey, and blue—was selected for its professional and accessible tone. Typography was chosen for both legibility and personality, using a modern sans-serif stack—primarily Segoe UI and Arial—for a clean and contemporary feel. Rounded square boxes were used to reinforce a minimalist and approachable aesthetic.

A key structural decision was to split the interface into two distinct pages: the first featuring an interactive map, and the second presenting core trade statistics. This separation reflects a deliberate contrast: the map is a powerful but complex exploratory tool, while the statistics page is more guided and user-friendly. For the statistics page, we intentionally did not use the full dataset. Instead, we relied on static '.json' files that directly store the required data, simplifying the technical implementation.

This trade-off—reducing interactivity in favor of clarity—was intentional. The map offers deep, exploratory interaction, while the statistics page provides clear, focused insights. This dual design caters to different user needs and balances flexibility with usability.

2.1 Usage of an AWS Database and Lambdas

Although preprocessing the data was very useful for displaying features statistics, it was not a feasible solution for the map view. As it requires a search amongst almost 50 millions entries of data and an aggregation on the fly of the relevant entries. This was just not possible within the browser and a reasonable amount of time given the size of the dataset.

We first looked into storing the raw CSV files on Amazon S3 buckets and fetching the data on demand. However after setting this up, we realized this was just moving the problem from the browser to a server, the computation time needed was still around 2 mins for 1 query.

We explored precomputing the aggregations and storing them in separate CSV files on Amazon as well, however this was still quite slow as well around 1 min for 1 query.

Finally, we opted to upload the dataset into an Amazon Postgres Database. This sped up the queries for specific tariff numbers; however, it was not sufficient if we were interested in a category / aggregation of tariffs. Therefore, we also created Materialized Views in the database that precompiled all the aggregations that we knew we would need.

The access to the data stored in the Database on AWS was exposed through 2 API endpoints using AWS Lambdas, one for import data and one for export data. We can query based on a specific range of years, a specific country, and a type of tariff (specific or grouped).

3 Sketches and Iterations for the Map Page

We started by going back to our sketch from milestone 2 as shown in Figure 1. The layout of the map page evolved as we developed each component and realized that it looked far too cluttered. This resulted in setting limitations for the selectors and dynamically displaying the graph on the web page only after all search criteria were decided, as can be seen in Figures 5 and 6.

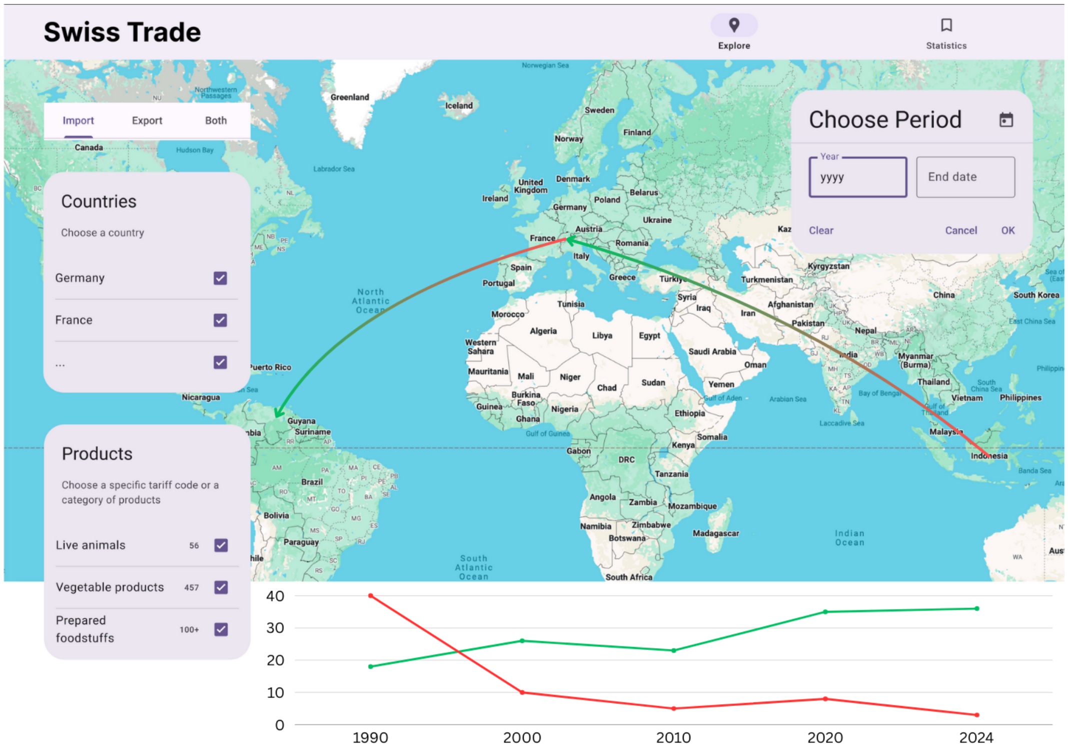


Figure 1: Original conception for the Map page

The development of the Map page was very closely intertwined with the data access challenge. Often after developing a feature and hoping to test it, we would realize that the response time was slow and would need to look for an alternate solution.

3.1 Selectors

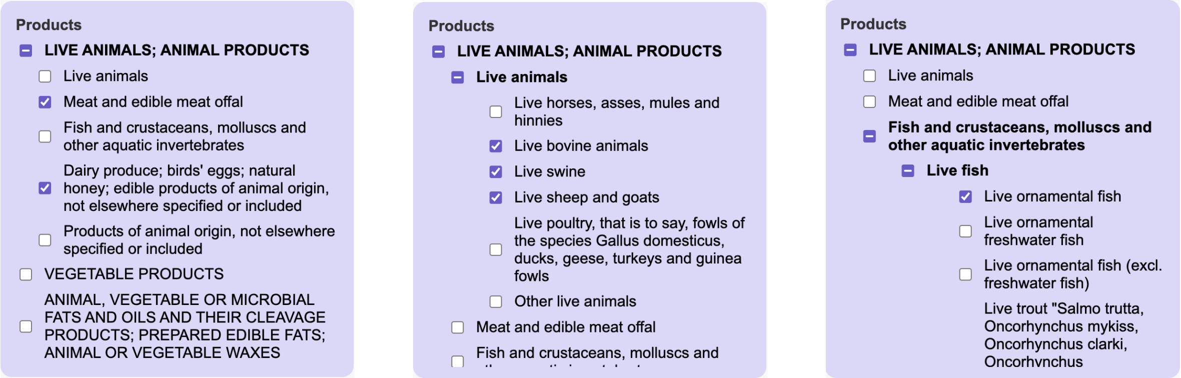
We started by developing the country selector and the period selector. We wanted to be able to interactively click on the map to choose a country. We needed to create a mapping between the country on the map and the country id number from our dataset. Since the country name wasn't sufficient for a complete mapping, we relied on a mixture between country name and country code.

For the period of time selector, we opted to change the years and make it more specific as month and year. Our dataset provides trade data per month and year, so including this option allows us to exploit more fully our dataset.

3.1.1 Product selector

This was the most challenging selector to create. We realized that we couldn't just list all 15'000 specific tariff numbers and corresponding names. It isn't very user-friendly, and doesn't allow a user to gain any general insight about the dataset. We needed to find a way to select a group of tariffs at the same time.

We researched to understand how the tariffs are structured and categorized, we realized that there is a hierarchy inherent to the numbering system. Tariffs belonging to the same category are have the same prefix. We did some data restructuring to obtain this tree structure and changed our product selector to reflect that as well as can be seen in Figure 2.



Products

⊟ LIVE ANIMALS; ANIMAL PRODUCTS
- □ Live animals
- ☑ Meat and edible meat offal
- □ Fish and crustaceans, molluscs and other aquatic invertebrates
- ☑ Dairy produce; birds' eggs; natural honey; edible products of animal origin, not elsewhere specified or included
- □ Products of animal origin, not elsewhere specified or included

□ VEGETABLE PRODUCTS

□ ANIMAL, VEGETABLE OR MICROBIAL FATS AND OILS AND THEIR CLEAVAGE PRODUCTS; PREPARED EDIBLE FATS; ANIMAL OR VEGETABLE WAXES

(a) Top category

Products

⊟ LIVE ANIMALS; ANIMAL PRODUCTS
- ⊟ **Live animals**
  - □ Live horses, asses, mules and hinnies
  - ☑ Live bovine animals
  - ☑ Live swine
  - ☑ Live sheep and goats
  - □ Live poultry, that is to say, fowls of the species Gallus domesticus, ducks, geese, turkeys and guinea fowls
  - □ Other live animals
- □ Meat and edible meat offal
- □ Fish and crustaceans, molluscs and

(b) Sub category

Products

⊟ LIVE ANIMALS; ANIMAL PRODUCTS
- □ Live animals
- □ Meat and edible meat offal
- ⊟ **Fish and crustaceans, molluscs and other aquatic invertebrates**
  - ⊟ **Live fish**
    - ☑ Live ornamental fish
    - □ Live ornamental freshwater fish
    - □ Live ornamental fish (excl. freshwater fish)
    - Live trout "Salmo trutta, Oncorhynchus mykiss, Oncorhynchus clarki, Oncorhynchus

(c) Specific Tariff

Figure 2: Hierarchical structure of the tariffs

Once we finished designed and structuring our selectors, we realized that they would need to take up more horizontal space than original expected. However, since we originally planned to have them overlay on the map and dispersed on the web page, the whole website just started to look too cramped. Juggling where to place a selector while being careful not to cover up a country was not easy.

As a result, we opted to move all our selectors together to the left so that the map can be clearly visible and all the selectors grouped together in a harmonious and clear manner.

3.2 Trade Trends Graph

At first, we implemented the display of the trade trends graph underneath the map. However, this looked a bit strange, the graph looked out of place and it wasn't even clear that the user is supposed to scroll in order to see the graph. Also, the contrast with the map above just wasn't very pretty.

So we changed it up and decided that the map had be the center of attention. We did not to scroll on the map page, so we implemented a slide up pop up from the bottom of the page of that shows the graph, as can be seen in Figure 5 and 6. We also noticed that due to the varying range of period of time, the x-axis could become very cluttered. So, we also implemented a bins aggregation system to overcome this visual challenge. These changes greatly improved the aesthetics of the page and were much more intuitive from a user point of view.

3.3 Search Criteria

We hoped to allow the user to choose freely amongst all the options available. We tested this out by selecting 3 countries, both import and export, and multiple products, however our graph was no longer digestible. It had far too many lines and the ranges on the y-axis weren't always matching up, so some lines would be completely flattened to 0.

We realized that we need to set some limitations on the search criteria, but we wanted to still keep a maximum of liberty. We started by reducing the country choice to one. The type of trade (import, export, or both) remained. The period of time can be freely chosen between 1988 - 2023. The tariff category can also be chosen freely by the user, we opted to allow the user to wisely choose a good quantity of products.

4 Sketches and Iterations for the Statistics Page

The evolution of the *Statistics* page went through multiple iterations before reaching the final design, as shown in Figure 4 in the Annexes. Figure 3 displays earlier hand-drawn sketches: the initial idea on the left, and an intermediate concept on the right. The development of this page can be analyzed through two lenses—technical improvements and readability enhancements.

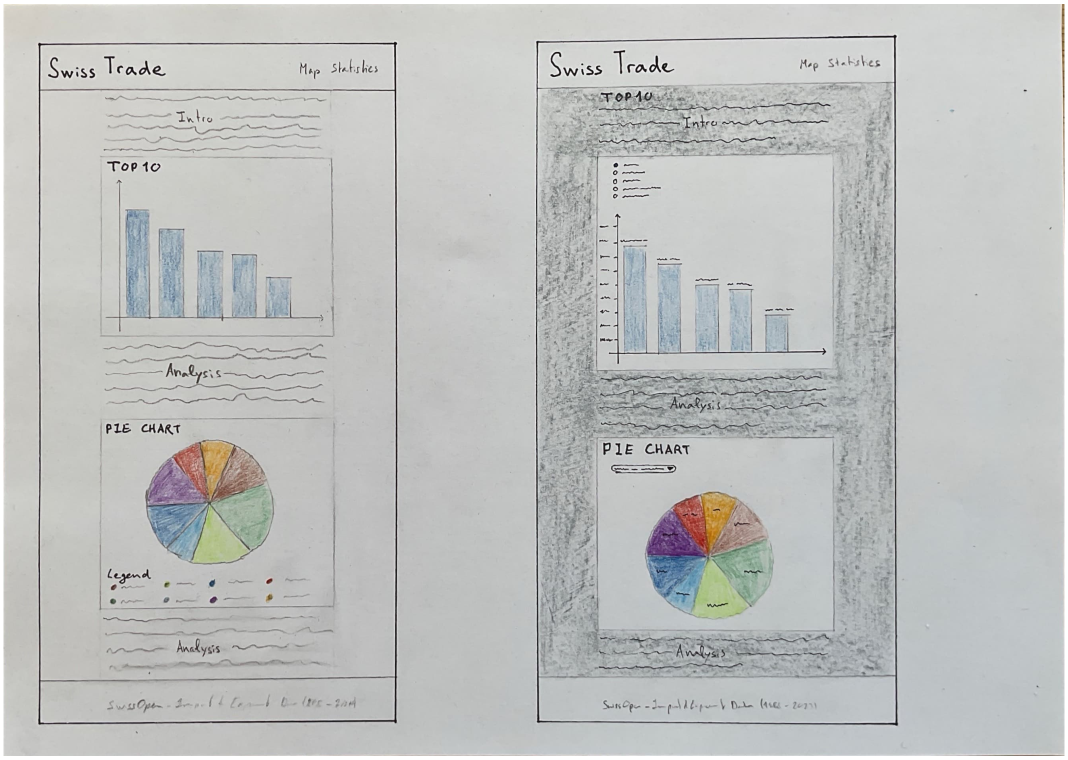


Figure 3: Sketches of the Statistics page – initial and intermediate concepts

4.1 First Version: Basic Layout

The initial design featured two simple graphs, each with a basic title and short descriptive text. It lacked interactive elements and detailed labeling, making it difficult for users to engage with the content meaningfully.

4.2 Second Version: Improved Interaction and Readability

In the second version, we introduced key technical features:

- The first graph was paired with a checklist for filtering.
- The second graph used a scrollable list of categories.

This increased user interaction significantly. We also noticed that we forgot the labels in the first version, making comprehension harder.

From a readability standpoint, we adjusted the background color to better separate the two graphs visually. Although the final version uses a lighter background, this intermediate version explored using a darker one. We removed the general introduction and instead used a strong title to immediately capture attention. For the pie chart, labels were embedded directly within the slices to enable faster interpretation.

4.3 Final Version: Enhanced Functionality and Aesthetics

The final version (Figure 4) added several refinements:

- Interactive tooltips appear when hovering over data points.
- Highlighting improves focus on selected parts of the graph.
- Side-by-side pie charts replaced the long scrollable list, cutting the number of categories in half while making comparisons more fluid and topic-relevant.

We also added italicized contextual text after the first graph to explain key insights. This allowed us to remove the transitional analysis paragraph and instead begin the second part with a direct, attention-catching title. To enhance clarity, we removed labels from small pie slices and relied on clear, consistent coloring.

The color palette used is ‘d3.schemeTableau10‘, a predefined array designed for clarity and accessibility. As noted by Mathis and supported by creators [1], these colors are optimized for colorblind users and maintain visual distinction.

5 Conclusion

The development of the Swiss Trade Visualizer was a rewarding journey that combined technical problem-solving with user-focused design. We worked with a large and complex dataset and built an interface that balances clarity with depth. The result is a functional and engaging platform that allows users to explore over four decades of Swiss trade data in a meaningful way. The experience showed us how powerful data visualization can be in turning raw information into clear and useful insights, while also strengthening our technical and design skills.

Looking back, focusing on a single product category (such as food or textiles) might have made things simpler. It could have reduced some data challenges and given us more space to develop storytelling and highlight interesting facts.

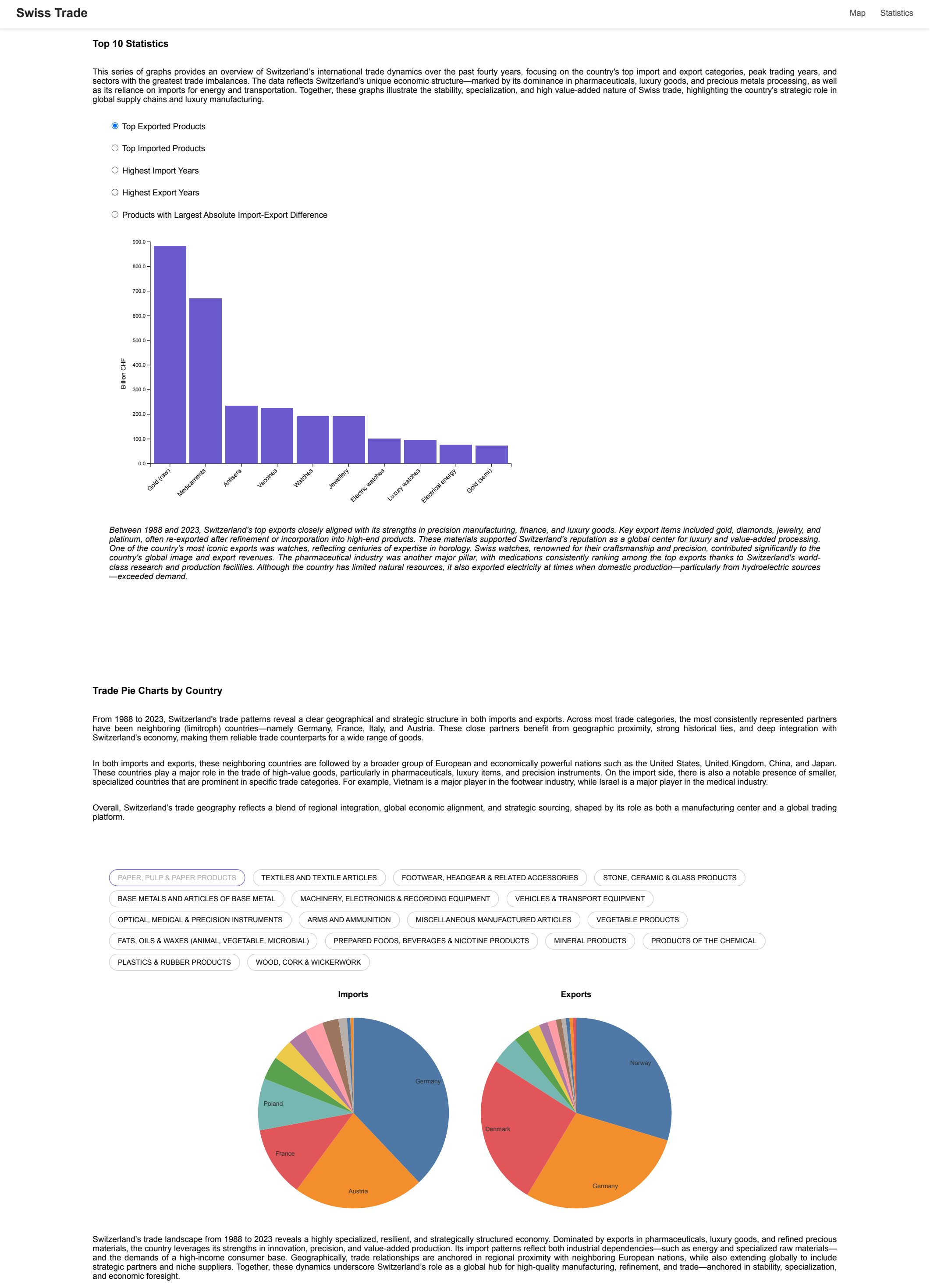
6 Peer assessment

Unfortunately, Robin left the team after Milestone 2. For the remainder of the project, the work was divided and carried out in parallel. Tatiana focused on creating the map and designing the dataset query, while Mathis handled the statistical analysis and contributed the majority of the content for the process book.

References

[1] Maureen Stone. *How we designed the new color palettes in Tableau 10.* Accessed: 2025-05-29. 2016. URL: https://www.tableau.com/blog/colors-upgrade-tableau-10-56782.

7 Annexes



Top 10 Statistics

This series of graphs provides an overview of Switzerland's international trade dynamics over the past fourty years, focusing on the country's top import and export categories, peak trading years, and sectors with the greatest trade imbalances. The data reflects Switzerland's unique economic structure—marked by its dominance in pharmaceuticals, luxury goods, and precious metals processing, as well as its reliance on imports for energy and transportation. Together, these graphs illustrate the stability, specialization, and high value-added nature of Swiss trade, highlighting the country's strategic role in global supply chains and luxury manufacturing.

● Top Exported Products

○ Top Imported Products

○ Highest Import Years

○ Highest Export Years

○ Products with Largest Absolute Import-Export Difference

Between 1988 and 2023, Switzerland's top exports closely aligned with its strengths in precision manufacturing, finance, and luxury goods. Key export items included gold, diamonds, jewelry, and platinum, often re-exported after refinement or incorporation into high-end products. These materials supported Switzerland's reputation as a global center for luxury and value-added processing. One of the country's most iconic exports was watches, reflecting centuries of expertise in horology. Swiss watches, renowned for their craftsmanship and precision, contributed significantly to the country's global image and export revenues. The pharmaceutical industry was another major pillar, with medications consistently ranking among the top exports thanks to Switzerland's world-class research and production facilities. Although the country has limited natural resources, it also exported electricity at times when domestic production—particularly from hydroelectric sources—exceeded demand.

Trade Pie Charts by Country

From 1988 to 2023, Switzerland's trade patterns reveal a clear geographical and strategic structure in both imports and exports. Across most trade categories, the most consistently represented partners have been neighboring (limitroph) countries—namely Germany, France, Italy, and Austria. These close partners benefit from geographic proximity, strong historical ties, and deep integration with Switzerland's economy, making them reliable trade counterparts for a wide range of goods.

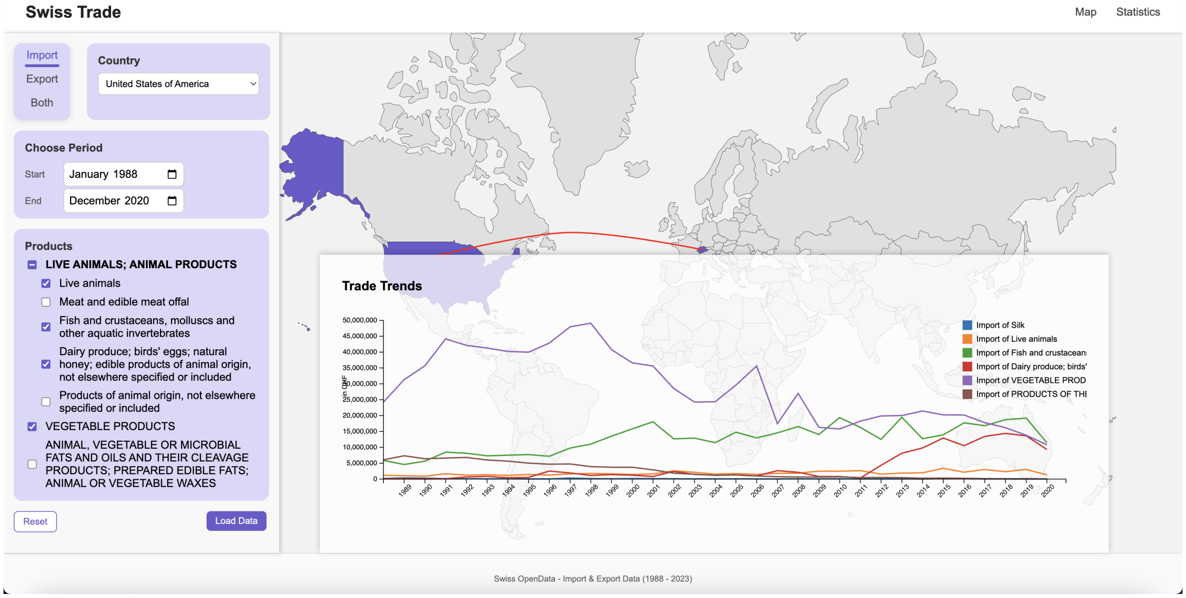
In both imports and exports, these neighboring countries are followed by a broader group of European and economically powerful nations such as the United States, United Kingdom, China, and Japan. These countries play a major role in the trade of high-value goods, particularly in pharmaceuticals, luxury items, and precision instruments. On the import side, there is also a notable presence of smaller, specialized countries that are prominent in specific trade categories. For example, Vietnam is a major player in the footwear industry, while Israel is a major player in the medical industry.

Overall, Switzerland's trade geography reflects a blend of regional integration, global economic alignment, and strategic sourcing, shaped by its role as both a manufacturing center and a global trading platform.

PAPER, PULP & PAPER PRODUCTS
TEXTILES AND TEXTILE ARTICLES
FOOTWEAR, HEADGEAR & RELATED ACCESSORIES
STONE, CERAMIC & GLASS PRODUCTS
BASE METALS AND ARTICLES OF BASE METAL
MACHINERY, ELECTRONICS & RECORDING EQUIPMENT
VEHICLES & TRANSPORT EQUIPMENT
OPTICAL, MEDICAL & PRECISION INSTRUMENTS
ARMS AND AMMUNITION
MISCELLANEOUS MANUFACTURED ARTICLES
VEGETABLE PRODUCTS
FATS, OILS & WAXES (ANIMAL, VEGETABLE, MICROBIAL)
PREPARED FOODS, BEVERAGES & NICOTINE PRODUCTS
MINERAL PRODUCTS
PRODUCTS OF THE CHEMICAL
PLASTICS & RUBBER PRODUCTS
WOOD, CORK & WICKERWORK
Imports
Germany
Poland
France
Austria
Exports
Norway
Denmark
Germany

Switzerland's trade landscape from 1988 to 2023 reveals a highly specialized, resilient, and strategically structured economy. Dominated by exports in pharmaceuticals, luxury goods, and refined precious materials, the country leverages its strengths in innovation, precision, and value-added production. Its import patterns reflect both industrial dependencies—such as energy and specialized raw materials—and the demands of a high-income consumer base. Geographically, trade relationships are anchored in regional proximity with neighboring European nations, while also extending globally to include strategic partners and niche suppliers. Together, these dynamics underscore Switzerland's role as a global hub for high-quality manufacturing, refinement, and trade—anchored in stability, specialization, and economic foresight.

Figure 4: Final version of the statistics page



Country

United States of America

Choose Period

Start January 1988

End December 2020

Products

⊟ LIVE ANIMALS; ANIMAL PRODUCTS

☑ Live animals

□ Meat and edible meat offal

☑ Fish and crustaceans, molluscs and other aquatic invertebrates

☑ Dairy produce; birds' eggs; natural honey; edible products of animal origin, not elsewhere specified or included

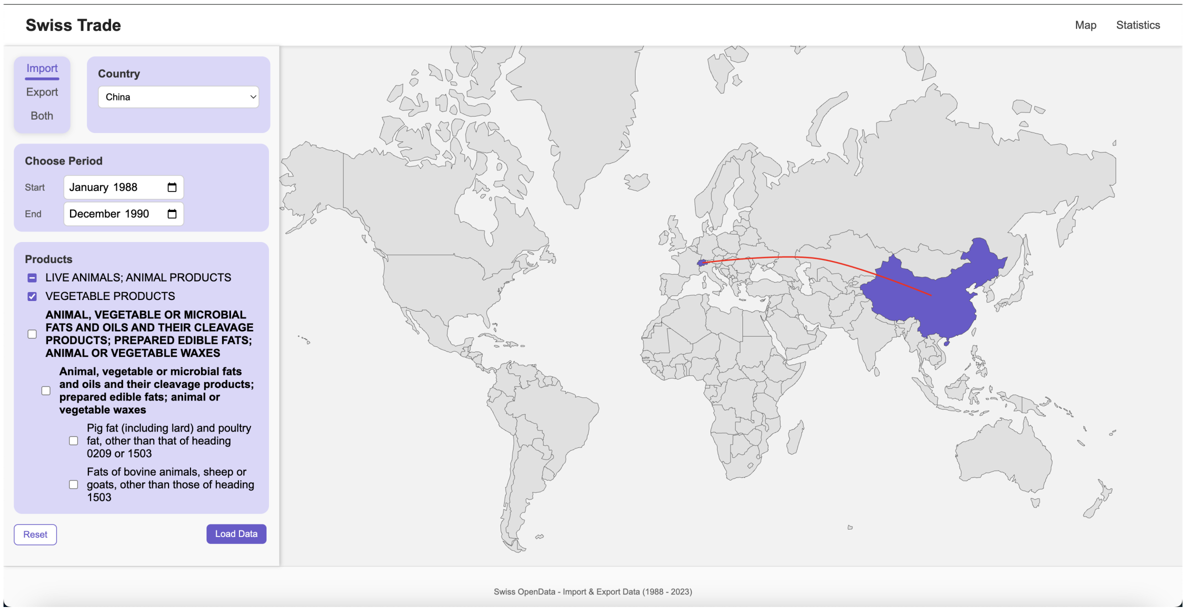
□ Products of animal origin, not elsewhere specified or included

☑ VEGETABLE PRODUCTS

□ ANIMAL, VEGETABLE OR MICROBIAL FATS AND OILS AND THEIR CLEAVAGE PRODUCTS; PREPARED EDIBLE FATS; ANIMAL OR VEGETABLE WAXES

Swiss OpenData - Import & Export Data (1988 - 2023)

Figure 5: Example of Map page with graph based on search criteria



Country

China

Choose Period

Start January 1988

End December 1990

Products

⊟ LIVE ANIMALS; ANIMAL PRODUCTS

☑ VEGETABLE PRODUCTS

□ **ANIMAL, VEGETABLE OR MICROBIAL FATS AND OILS AND THEIR CLEAVAGE PRODUCTS; PREPARED EDIBLE FATS; ANIMAL OR VEGETABLE WAXES**

□ **Animal, vegetable or microbial fats and oils and their cleavage products; prepared edible fats; animal or vegetable waxes**

□ Pig fat (including lard) and poultry fat, other than that of heading 0209 or 1503

□ Fats of bovine animals, sheep or goats, other than those of heading 1503

Swiss OpenData - Import & Export Data (1988 - 2023)

Figure 6: Example of Map page without graph during selection phase