

École Polytechnique Fédérale de Lausanne

Process Book

Data Visualization Project

By Pie Chart Masters



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>>> Introduction

>>> In this project, we developed a website aimed at providing a broad overview of the 2008 financial crisis, from its origins to its consequences, using interactive and diverse visualizations.

>>> We designed the website to guide users step-by-step through various sections, each featuring an interactive visualization. At first, users can explore these visuals freely, without immediate context. When they want more context, they can click the [?] button in the corner to uncover the purpose of each visualization and the insights it offers. The website is structured vertically, the user can scroll down using his mouse, arrows or clicking on the buttons on the right to move from one section to another.

>>> As such, our website offers users an accessible view of advanced data related to the crisis. This includes macroeconomic indicators, such as the rise in mortgage defaults symptomatic of the housing bubble burst, alongside economic metrics hinting at the crisis's root causes. The website also focuses on the devastating consequences of the crisis, from the global shock in terms of unemployment and GDP growth, to the widespread collapse of major financial institutions, and the dramatic stock market crash. Finally, our project explores social signals of the crisis by analyzing trending online topics as they evolved over time.

(P.S *The appearance of this report is directly inspired from the "Bloomberg Terminal", one of the main tool used in finance around the world.*)

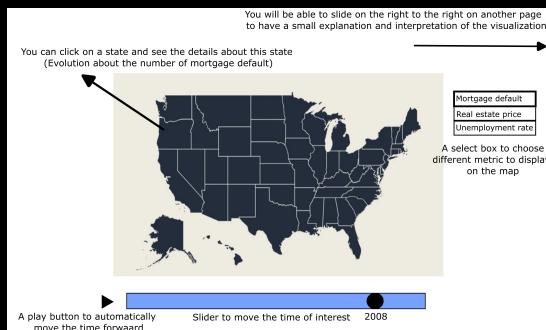
>>> General Website structure (*Designed by Marc*)

>>> The final rendering of the website is close to what we originally hoped to achieve. The idea is to have a website with a single scroll direction to help the user discover the visualizations in the order we thought most relevant. We tried to make the visualizations as immersive as possible, with as much interaction with the user as possible to capture the reader's attention.

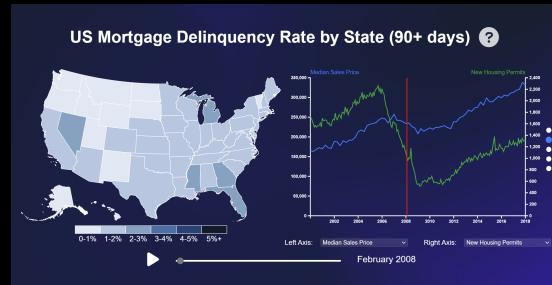
>>> Originally, we thought we'd include an horizontal scroll to the right to get to a secondary page explaining the visualizations for each section. Eventually, we adopted a more user friendly mechanic by clicking on a button (a question mark next to the titles) to display a pop-up window with explanation.

>>> The main problems that we haven't been able to resolve overall lie in scroll management (mouse, pad, touch screen, etc.) so that the site behave the same way with all the different types of scroll. We also failed to ensure that the layout of the elements and their size could be adapted to all screen and window sizes. And finally, to ensure that the visualizations behaved in the same way on all browsers.

>>> US mortgage default visualization (*Designed by Marc*)



(a) Initial idea — draft design of the mortgage default map.



(b) Final implementation — interactive map showing US mortgage delinquencies over time.

Figure 1: Comparison between the conceptual draft and the realized visualization of the USA mortgage default map.

>>> Compared to the draft view at Milestone 2, the rendering is close to the desired rendering, if not better for some elements.

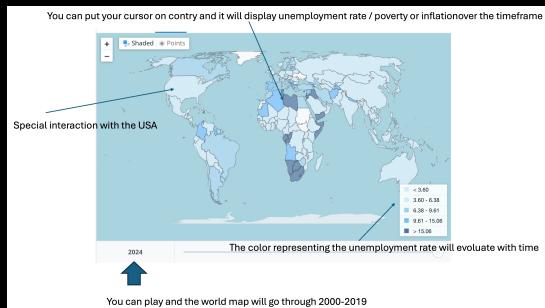
>>> We do have a map of the United States with a slider and a play pause button that animates the map according to the dates. You can also click on the states to see the precise information for that state.

>>> What has changed compared to Milestone 2, is the manner with which secondary economic indices such as the unemployment rate, property prices, etc. are displayed. The choice we made is to plot a graph next to the map that is synchronized with the timing of the map and the slider (red line moving according to the dates) in order to understand the dynamics of the indices and whether they could trigger or be influenced by the crisis.

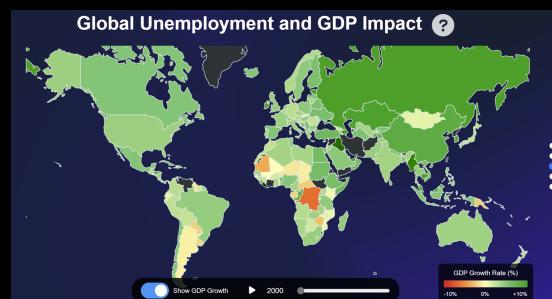
>>> A problem we encountered when visualizing the US map was the dataset we wanted to use initially. We had intended to use the HMDA dataset (as mentioned in milestone 1), but this dataset was very large (and therefore very heavy, with several GB per year). This made it difficult to manipulate. In addition, the temporal granularity was by year and no more precise, which didn't fit what we wanted to do.

>>> One of the major problems we encountered here was arranging the various elements on the window so that their size and layout were harmonious, while ensuring that everything remained visible in the same window (without the slider being "pushed" out of the window because other elements would take up too much space).

>>> **Global Unemployment and GDP Impact (Designed by Jerome)**



(a) Initial idea — static design sketch for economical indices world map.



(b) Final implementation — interactive and animated world map visualization.

Figure 2: Comparison of the conceptual design and the implemented visualization for GDP and Unemployment world map.

>>> Our global unemployment and GDP visualization closely aligns with the original vision from Milestone 2, with some improvements in interactivity and data presentation.

>>> The interactive world map features a timeline slider and play/pause functionality that animates the data progression through the years. Users can toggle between unemployment rates and GDP growth indices, providing a global view of the economic impact during the 2008 financial crisis. Clicking on individual countries reveals detailed time series data, allowing for deeper analysis of specific regions.

>>> One significant change from Milestone 2 is the removal of the special interaction with the United States in this visualization. We realized this feature would be redundant given the detailed US mortgage delinquency visualization in the previous section.

>>> A key technical challenge we overcame was data harmonization. Working with unemployment [1] and GDP [2], data from different sources, required careful processing to ensure consistent country naming and temporal alignment.

>>> Bank Collapse Bubbles (*Designed by Eliot & Jerome*)

>>> This visualization was modified multiple times before reaching its final form. The original data [3] identified the collapse by country and not by coordinates, so it was required to convert the data to a longitude/latitude structure. A lot of transaction sizes were missing, so a fraction of the mean of transactions was used as a proxy to have a proper visualization.

>>> First, a world map was created with leaflet, utilizing the features of coordinates to easily plot the bubbles. The map was working with a dynamic cursor to move through time with either a manual or automatic mode. When clicking on the USA bubble, a pop-up frame was displaying another dataframe, FDIC's failed bank list to show that not only major institutions but also regional banks in the US were strongly affected during the crisis.

>>> After some reflection, it was decided that the appearance of the leaflet map, even when using a dark mode, was too different from the US mortgage and the world map for unemploy-

ment. We had two choice : either replicate the map style produced in the Unemployment Map or try to implement the bubble feature to the map. We thought that a repetition of a world map would've been heavy for the style of the website so we took the path of implementing the bubble feature to the unemployment map.

>>> Adding this feature caused additional trouble, the data originally showed on the visual - unemployment and GDP growth - was yearly sampled, so we had to reconfigure the cursor such that, when reaching 2007, it switched to monthly steps to properly display the bubble, switching back to yearly steps afterwards.



(a) Initial idea — individual page with dynamic bar chart of the banks writedowns



(b) Final implementation — In-page pop-up of the bar chart included in the stock indices section

Figure 3: Comparison of the conceptual design and the implemented visualization for banks collapse bubble map

>>> Stock index chart (*Designed by Eliot*)



(a) Initial idea — static design sketch for stock index evolution.



(b) Final implementation — interactive and animated stock index visualization.

Figure 4: Comparison of the conceptual design and the implemented visualization for global stock index evolution.

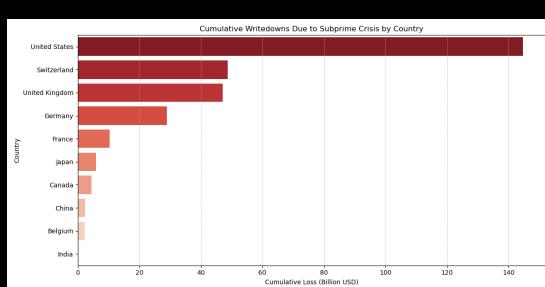
>>> For this section, the first challenge was encountered while trying to fetch the financial data [4]. The yahoo finance library failed to download data of stock **indices**. In the end we ended up scrapping the data from the yahoo finance website before processing it. To have the best possible visualization that could compare the performance in the clearest way, we decided to go with cumulative returns on a 1\$ investment, to have paths of the same scale.

>>> In the end, we decided not to implement a brush function to zoom the data as its imple-

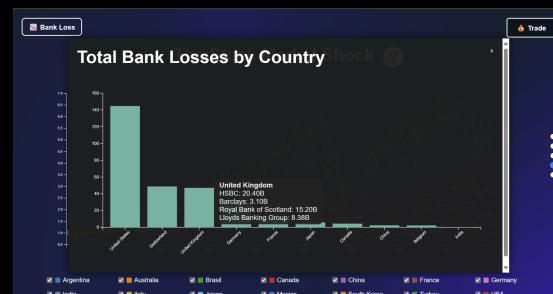
mentation appeared very heavy for the website. As we intended we added a filter option to select which indices to display.

>>> In addition, we added a new feature, a **trade button** that allows the user to virtually take a position in 2003 on an index of its choice and see its profit or loss in 2012.

>>> Originally, we had plan to add a second visualization, a bar chart of the biggest writedowns per country to see which were the biggest losers of the financial crisis. It was suppose to be accessible by scrolling horizontally to the right. In the end, since we abandoned this website structure to avoid complicated 2D navigation for the users, we added instead a **bank loss** button in the top left corner. This button opens a page with a bar chart that display the total writedowns per country, when hovering with the mouse, it display the individual writedowns per banks.



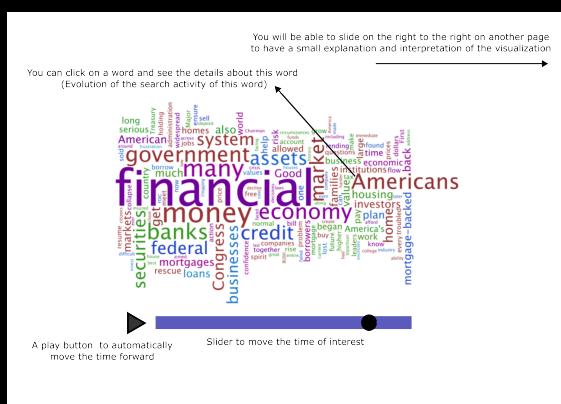
(a) Initial idea — individual page with dynamic bar chart of the banks writedowns



(b) Final implementation — In-page pop-up of the bar chart included in the stock indices section

Figure 5: Comparison of the conceptual design and the implemented visualization for the banks wriedown bar chart

>>> The Word cloud (*Designed by Marc*)



(a) Initial idea — draft design of the word cloud



(b) Final implementation — interactive word cloud showing Google search trends for several words.

Figure 6: Comparison between the conceptual draft and the realized visualization of word cloud

>>> The rendering of this visualization is very much in line with what was planned for milestone 2. You can click on any word in the wordcloud to see the time-series of the evolution of searches on that particular word. There is also a slider to change the reference date, and a play button to animate the wordcloud automatically.

>>> We had two main problems with this visualization. The first was how to determine the size of the words in order to highlight, as desired, the fear of the population during the crisis. Indeed, if we determine the size of the words with the absolute value of the searches, it doesn't render very well because the enlargement of these words won't necessarily be visible compared to the size of the generic words which are large because they are frequently searched at all times. We therefore used a fear score calculated in relation to the average number of searches for each word, which enabled us to optimize word size for the desired purpose. In addition, due to the Google Trends API, it was complicated to make a lot of requests for word trends because after a certain number of requests the API blocked us and limited our tests.

>>> The second problem was to find smooth transitions between each timestep. Indeed, we found that the transitions could be enhanced, but unfortunately we couldn't find any solutions.

>>> Conclusion

This project resulted in a website that fulfilled its goal, presenting a clear and interactive overview of the 2008 financial crisis. Each section uses visualizations to highlight key aspects of the crisis, including rising mortgage defaults, global economic indicators, the collapse of financial institutions, stock market trends, and shifts in public interest.

Despite challenges such as scroll behavior across devices, layout consistency, and data processing, we think we delivered a functional and engaging user experience.

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