

GED VIZ: A Web Tool for Exploring and Sharing Global Economic Relations

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ABSTRACT

In this paper, we present GED VIZ, a freely accessible web tool that supports data exploration and data-driven storytelling about global economic relations. The tool visualizes flows of trade, migration and finance between 2000 and 2012 among a user’s choice of up to 47 countries, including the EU, the OECD and the BRICS countries. In particular, GED VIZ introduces a novel mechanism to produce slideshows of interactive visualizations that can be embedded into other webpages. The tool thus bears a great potential for use in data-driven journalism.

Keywords

data visualization, storytelling, data-driven journalism, visual exploration, web tool, economics, relational data

1. INTRODUCTION

Making sense of our world at a time of rapidly growing complexity is becoming more and more of a challenge—for decision-makers as well as for the public at large; for researchers as well as for teachers; for managers and politicians as well as for journalists. At the same time, the increasing availability of data, tools and algorithms provides fundamental building blocks for the empowerment of people meeting this challenge.

Bridging the gap between data—reflecting the complexity of our world on the one hand—and knowledge—providing meaningful orientation on the other hand—requires a number of competencies that only a few experts share, such as in the fields of data analysis, statistics, information design or programming.

Data visualization is central to both understanding and communicating the interdependent developments of our globalized economy. “Knowledge brokers” such as researchers, teachers and journalists need to be supported in generating visualizations and in integrating these into their knowledge-sharing or story-telling processes.

In the last few years, the number of available visualization tools has been increasing rapidly. However, the media mostly address globalization in terms of competition: “When will China overtake the U.S. as the world’s largest

economy?”, “Who will be this year’s export champion?” In fact, these questions only relate to comparisons of the *outcomes* of globalization. By contrast, globalization itself, by its very definition, is about *relations, exchange* and *interdependencies* between countries.

In summary, journalists and other “knowledge brokers” who would like to contribute to a better understanding of global issues, face three major challenges:

- the challenge of understanding globalization through relational data;
- the challenge of accessing (relational) data and making sense of them; and
- the challenge of easily producing visualizations and integrating them into storytelling.

In July 2013, the Global Economic Dynamics (GED) team of the Bertelsmann Foundation launched its web-based tool *GED VIZ* for visualizing data on global economic dynamics. It focuses on flows of trade, finance and migration, thus showing what globalization is about: mutual dependencies. The tool’s core feature allows to produce *interactive slideshows* of user-generated displays that can be embedded into other webpages. It thus helps to tackle all of the three challenges mentioned above—GED VIZ is a tool to *explore and share what globalization is about*.

The purpose of this paper is to present the main features of the tool (Section 2) and how they benefit data-driven journalism (Section 3), to share some background on the development process (Section 4) and to discuss current limitations and directions of future development (Section 5).

2. INTRODUCING GED VIZ

GED VIZ visualizes annual data of merchandise trade flows, migration flows and foreign bank claims between any choice among 47 countries, including the OECD, the EU and the BRICS countries, from 2000 to 2012. In addition, 16 *country indicators* such as GDP or unemployment can be added to the visualization (in multiple units such as “total” or “per capita”). All data have been drawn from public sources at AMECO, BIS, OECD and UN Comtrade.

Several features support visual data exploration: Users can discover changes over time, display strongest connections

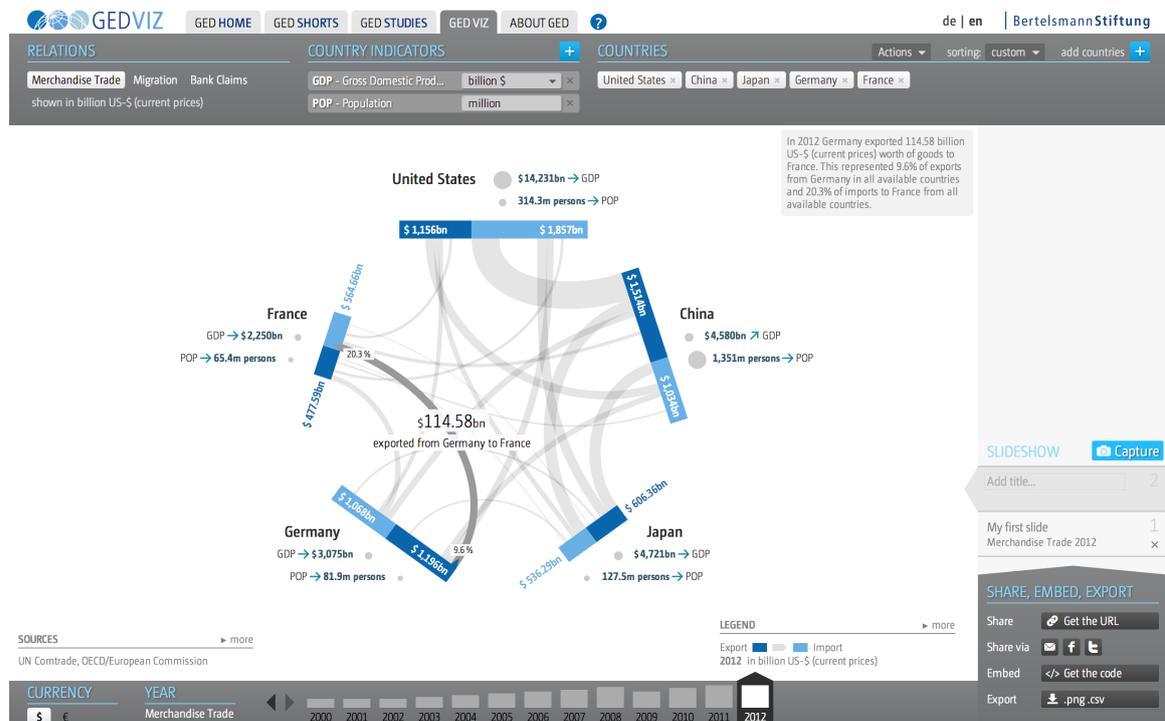


Figure 1: A screenshot of GED VIZ (<http://viz.ged-project.de>)

between countries, work with country groups (either predefined such as EU or BRIC, or user-defined) or use helpful sorting functions.

Visualizations can be captured as *slides* to form *slideshows* that can be embedded into other webpages or shared via email, Facebook or Twitter. Export of underlying data and static graphics is also provided. To show how to use embedded slideshows in storytelling about global developments, a number of showcase articles has been provided at <http://www.ged-project.de/viz/> under “GED VIZ in Action” (in English and German).

GED VIZ is generally best experienced with a modern browser, on a large screen and in full-screen mode. Figure 1 shows a screenshot of the tool. Since it is based on HTML and JavaScript, it also runs on tablets and other mobile devices. GED VIZ supports HTTPS embeddings of slideshows.

In the following, we describe the tool’s parts and features in detail.

2.1 Visualization Canvas

The tool’s central part is the visualization canvas showing the user’s choice of countries and country groups which are represented by bars arranged in a regular polygon. The darker part of each bar reflects the *outflows* of the selected bilateral indicator (exports, foreign bank claims or emigration), while the lighter part reflects the corresponding *inflows* (imports, foreign debt or immigration).

The light-grey connections between the country bars indicate the flows between countries. When hovering over a connection, the corresponding amount is shown, together with shares of outflows and inflows at the ends of the connection. In addition, an explanatory text box in the upper right part

of the canvas describes the meaning of the displayed data. Missing data are indicated by “n/a”, explanatory texts also refer to them. By clicking on either a bar or a connection, the highlighting is “frozen,” i.e., it remains highlighted when moving the mouse pointer away. When capturing slides (see below), the “freezing” persists.

Next to the country bars, up to five country indicators (e.g., GDP, unemployment rate, inflation) are shown with abbreviations, tendency arrows, figures and small pictograms. Hovering over country indicators shows the indicator’s rate of annual change, full description and unit. Data sources are shown (with links) in the lower left part of the visualization, and an expendable legend explaining all displayed visual elements is available in the lower right part.

2.2 User Interface

The bilateral indicator to be displayed can be selected in the *Relations* panel (upper left). Country indicators can be added and deleted in the corresponding panel next to it. Units (e.g., total amounts or per capita) can be changed via drop-down menus.

Countries are added to the visualization (upper right) either by direct search or by filtering. In the visualization, countries are ordered clockwise, starting at 12 o’clock, according to the order in the *Countries* panel. The order can be changed either manually by drag-and-drop in the *Countries* panel or automatically according to a selected data variable by choosing from the *sorting*: drop-down menu (upper right). Selected countries can be grouped in the *Actions* menu to be shown as a single bar in the visualization. Hovering over a group in the *Countries* panel reveals the group members in a tool-tip.

If a single country or country group is selected in the *Countries* panel, it is possible to “Add 5 related” countries via the *Actions* menu: There is a choice between adding (a) countries having the largest sum of flows (e.g., Export + Import) with the selected country; (b) countries being destinations for the largest outflows of the selected country (e.g., Export) or (c) countries being sources of the largest inflows of the selected country (e.g., Import).

The currency can be toggled between USD and EUR (lower left); the year according to which data is visualized can be selected in the lower part. The bars above the years indicate the sum of all flows among the displayed countries.

2.3 Slideshows

The *slideshow* concept is the tool’s most prominent feature: Visualizations can be captured to create a slideshow (lower right area) that can then be easily embedded into other web pages via an *iframe*. Slides can be easily renamed, removed or reordered (by drag-and-drop).

Once at least one slide has been captured, the *Share*, *Embed*, *Export* functions show up just below the *Slideshow* list. Users can get the URL linking to the current slideshow, share it via email, Facebook or Twitter, get an embed code for including the slideshow into other websites (with preview), or export static images or the data underlying the visualizations. The embed dialog allows to change the embedding width and to choose between different types of navigation (back/forward or play/pause buttons). Each time a URL or embed code is requested, a new slideshow ID is generated (provided that the slideshow linked to the current ID has been changed).

Embedded slideshows contain full source notes and legends. Visitors of websites containing slideshows may switch to full-screen mode or jump into the tool (linked in the lower right corner), where they find the “tool version” of the slideshow that they may want to manipulate on their own. The content linked with a slideshow ID will of course stay the same.

3. BENEFITS FOR DATA JOURNALISM

GED VIZ enables journalists and other knowledge-brokers with little or no design, data processing or programming skills to visually access complex macro-economic data and to enrich their story-telling with self-made interactive visualizations. It contributes to solving the three major challenges mentioned in the introduction by

- focusing on the visualization of relational economic data and their evolution over time;
- providing convenient access to macro-economic data (with an emphasis on relational data) and allowing to explore them visually; and
- providing a mechanism to easily produce interactive slideshows of user-generated visualizations and embed them into other webpages.

3.1 Enabling Storytelling About Relations

As mentioned in the introduction, globalization is mostly addressed in terms of comparisons of country-specific data.

Of course, this is what people are interested in the end—how does my country perform compared to others? And in fact, countries can learn from superior performers and possibly adopt their policies to catch up in the rankings. But this approach often overlooks an important fact: In times of rapidly increasing global connectedness, countries should no longer be treated as if they were independent entities. By contrast, globalization is inherently about what is happening *between* countries.

To understand the *dynamics* of globalization, we need to look at relations; to understand *outcomes*, we need to look at country-specific indicators. While the latter are integrated into the tool, too, the focus however is on relations, simply because other tools such as *Datawrapper*, *Tableau* or *Google Public Data* already do a terrific job with country-specific data. GED VIZ is the first web tool to produce easily configurable visualizations of relational data without any programming knowledge.

3.2 Visual Access to Relational Data

Relational data is somewhat hard to extract from the web. Sources are spread over the web, some are rather hidden and formats differ a lot (some data come as cross-tables, some as flat lists). Also, as mentioned above, relational data structures are more complicated to understand than country-specific data series. Interactive visualizations are an obvious tool to explore such data, although it turns out to be quite a bit of a challenge to design good layouts and to provide smooth animations to show changing configurations.

Technically, relational data can be represented as weighted directed combinatorial graphs (or networks). The signature tool to date for visualizing such graphs certainly is Gephi¹. Using Gephi however does require some technical skills, as data has to be loaded in a specific format, and the layout has to be configured in a number of steps. In contrast to Gephi, GED VIZ is a web application providing automatic production of interactive visualizations that run in a browser.

While many network visualizations found on the web display large datasets based on “big data,” networks in GED VIZ, with a maximum of 47 nodes, are rather small. The emphasis is thus on providing visual means to explore the full data set including changes over time, whereas in large networks, the focus is mostly on showing node clusters or central nodes, or on showing different network levels by zooming in and out of the network.

GED VIZ has no analytical or even predictive power; its sole purpose is to display established data. We believe that the first step in analyzing complex data should always be to visualize them, at least in a rudimentary way. Only then should suitable models be chosen for further analysis.

3.3 Production and Embedding of Slideshows

The step from data and visualizations to storytelling may be the hardest. In this step, the number of needed skills usually culminates: The data has probably been collected and analyzed by statisticians, econometricians or data scientists; the visualization has probably been built by designers, information architects and programmers; and the story to be told has probably been (or is to be) written by a journalist.

¹<https://gephi.github.io/>

In short, a well-functioning team of people with different capabilities is usually required. With GED VIZ, a single person can access and explore data, capture and name her own visualizations and embed them into another webpage. The result is not just a static graphic, but a slideshow of interactive visualizations, which can serve as a strong visual underpinning of a news story or blog post.

To the best of our knowledge, GED VIZ is the world's first tool to introduce such a mechanism. A similar technique—but just for one chart—had already been provided by the OECD Better Life Index,² where users can get an embed code for rankings based on their own weighting of indicators. Recently, *Tableau Software* has integrated an extension of the slideshow concept with the introduction of *story points* in its version 8.2.³

4. SOME BACKGROUND ABOUT THE DEVELOPMENT PROCESS

4.1 Original Motivation

GED VIZ was developed as part of the Global Economic Dynamics (GED) project at the Bertelsmann Stiftung, one of Germany's largest operating non-profit foundations. The GED project's goal is to make complex economic dynamics transparent and understandable. The initial inspiration for GED VIZ came from a New York Times info-graphic, "Europe's Web of Debt," that appeared on the Web in May 2010⁴ showing data on foreign bank claims. The idea was to build a tool that would allow users to produce similar infographics with a flexible set of self-chosen countries and to show changes over time.

4.2 Concept, Design and Programming

After building a prototype for foreign debt relations in fall 2010 that reproduced "Europe's Web of Debt"-style visualizations and that could also show changes over time, the visual language was radically rethought, the user interface was extended, more data was added and the slideshow and embedding concept was designed. This process was led by the authors of this paper, supported by Timm Kekeritz from Berlin-based design agency *Raureif*.⁵ <http://www.raureif.net/> Subsequently, the tool was programmed by a team at software agency *9elements*⁵ from Bochum, Germany, led by chief developer Mathias Schäfer.

4.3 Development Principles

Before and during the development process, a number of principles have been established that we believe are worth sharing, so as to provide transparency about the process but also as suggestions for general guidelines in similar endeavors.

Data selection

Data selection was guided by a demand for high quality, consolidated and publicly available data from reliable sources.

²<http://www.oecdbetterlifeindex.org>

³Read more about this concept in Robert Kosara's blog *eagereyes*, where he explicitly refers to GED VIZ, too: <http://eagereyes.org/blog/2013/story-points>.

⁴<http://www.nytimes.com/interactive/2010/05/02/weekinreview/02marsh.html>

⁵<http://web.9elements.com/>

To facilitate navigation, a high coverage with few data gaps was sought. This constrained the selection of countries to all major industrial and just the most important emerging countries. Additionally, to have a single timeline for all provided relational variables, the data frequency has been set to annual, ranging from 2000 to 2012.⁶

To ensure consistency between variables in different units, as much data as possible is derived from base data. E.g., unemployment in per cent of labor force is not taken as such from a public source, but is computed as the quotient of numbers for unemployed people and labor force; only the latter variables being taken from AMECO. Hence most values can be calculated for user-defined country groups as well.

Software development

When the project started, the greatest challenge was to develop the tool without *Adobe Flash* technology to ensure that it also runs on tablets. In hindsight, this decision was crucial for the tool's success. Another challenge was then to make sure that at least slideshows run in as many browsers as possible, so that, say, readers of news articles with embedded slideshows could view them in older browser versions as well.

Since a lot of code produced for GED VIZ is likely to be of use for third parties in the future, and since the Bertelsmann Stiftung is a non-profit foundation, it was clear from the start that the software would be made public under an open source license.⁷

User Interface

The user interface was designed to treat laypersons and experts alike; there is no special "expert mode" with extended functionality. Instead, tool-tips help to navigate through the tool, most of which disappear after some use. Clicking the support button ("?") opens an overlay with a tutorial video and links to a feedback form and further information including a version history.

The tool always shows a visualization of the current configuration of countries and data variables. This contrasts the common practice to first guide the user through a number of choices regarding countries, variables, years and layout options before delivering a corresponding visualization.

Less experienced users may thus explore the data by hovering over visual elements of the canvas, browse through time, maybe add or delete countries or change variables. More experienced users may additionally use the sorting and grouping features or create slideshows and share or embed them.

To keep the complexity low, we restrained from introducing a user management. As a consequence, users do not need to sign up. Current configurations are saved in the local browser cache, and slideshow IDs do not incorporate any information about their creators.

Visualization

The main purpose of data visualization is to help make sense of complex data. A general principle is to show as few things

⁶In principle, BIS bank claims are available quarterly at sufficient quality from 2000 on, whereas UN Comtrade data are available annually from the 1970s onwards. At the time of writing, the latest consolidated data published by these sources are from 2012.

⁷The software code is available at <https://github.com/bertelsmannstift/GED-VIZ>.

as possible, but as much as is necessary. Interactivity in the sense that the visual elements respond to user action, solves too challenges: firstly, it allows to display information only “on demand” (e.g., trade flow figures shown only when hovering over the corresponding connection). Secondly, interactivity helps a lot to engage the users in exploring (and literally discovering) the data.

As developments over time are of utmost importance to most stories about global dynamics, special emphasis is given to their visualization. Whenever the set of displayed countries is fixed and only the year is changed, the size of all visual elements are proportional to the underlying values. Moreover, transitions are interpolated smoothly, enabling the eye to catch important changes.

Evaluation

Following a user-centered design approach, an in-depth evaluation was built into the development process. Feedback from detailed interviews with a group of six professional usability testers as well as from an online survey taken by about 20 potential users (journalists, researchers, teachers) has been incorporated into the last development phase.

In addition, parallel to the tool’s launch, a group of 160 students from an undergraduate macro-economics course at the University of Siegen, Germany, was asked to work with GED VIZ and evaluate their experience. The findings showed a great potential for using the tool in both academic and secondary school teaching. Feedback was incorporated in later tool upgrades.⁸

4.4 Launch and Post-launch

GED VIZ was released and publicly presented at the event “Tell-a-Viz: Data, Visualization, Storytelling” in Berlin on July 2, 2013.⁹ Since then it has received a lot of attention from the design, visualization and software development communities. It was featured in renowned blogs such as Robert Kosara’s *eagereyes*,¹⁰ Nathan Yau’s *Flowing Data*,¹¹ *Designstagebuch*¹² and *GigaOm*.¹³ Furthermore, it has won a *Kantar Information is Beautiful Silver Award 2013* (tool category) and the *German Infographics Prize 2014* (science category), was shortlisted for the *GEN Data Journalism Awards 2014* and is currently nominated for the *LeadAwards* (category web-feature of the year), a long-established German media prize.

5. CURRENT LIMITATIONS AND DIRECTIONS OF FUTURE DEVELOPMENT

GED VIZ is not yet seen to be frequently used in online story-telling, although the number of occurrences of GED VIZ slideshows in blogs and news articles appears to be growing. We are aware of a number of current shortcomings that are likely to prevent many (data) journalists and other

⁸The results are available at http://www.ged-project.de/fileadmin/uploads/documents/GED_VIZ_2014_final.pdf (in German only).

⁹A documentation of the event is available at <http://www.ged-project.de/tell-a-viz> (in German).

¹⁰<http://eagereyes.org/blog/2013/ged-viz-data-storytelling-tool>

¹¹<http://flowingdata.com/2013/07/09/global-migration-and-debt/>

¹²<http://www.designstagebuch.de/datenvisualisierung-globalisierung-verstehen-und-vermitteln/>

¹³<http://gigaom.com/2013/07/09/follow-the-money-new-data-visualization-tool-helps-track-the-world-economy/>

economic experts from embedding GED VIZ slideshows more often:

- Stories using relational data are (still) scarce in general, as relational data are harder to deal with than “flat” data in a number of ways.
- The tool has hardly been advertised for publicly.
- Produced slideshows cannot be adapted in terms of fonts, colors and style, so that journalists cannot apply their “house style” to the slideshows.
- To date, GED VIZ does not provide data uploads by users. Consequently, stories told via slideshows are limited to the variables, countries and years included.
- Data in the tool are validated neither by the data-providing institutions, nor by independent institutions.
- Many news pages do not include third party visualizations (for technical, corporate or legal reasons).

Remedying these shortcomings does take quite a bit of an effort in terms of labor and monetary resources. We propose that future development should concentrate on the following issues, each of which is related to a more general challenge in data visualization and journalism:

- improve integration of text and visualizations, e.g., by adopting Tableau’s *story points* feature for GED VIZ;
- provide more data in the short-run and a data upload feature in the long-run;
- introduce flexible and configurable slideshow styles;
- combine GED VIZ with other tools such as MIT Media Labs’ *Observatory of Economic Complexity*,¹⁴ including the development of APIs;
- make code easier to re-use and encourage development of “derivatives”, i.e., similar tools visualizing other kinds of relational data;
- advance technical improvements such as adaption to smaller canvas size and responsive user interface.

6. CONCLUSION

We have introduced the web tool GED VIZ, its novel features, its benefits for data journalism and its potential for future development. To further unfold this potential, it will be crucial to lead many interdisciplinary discussions since solutions to the presented challenges are far from being straightforward. We will therefore need to continuously enlarge our community of users and supporters and to connect with like-minded people willing to invest in the future of data-driven, visualization-based story-telling. We hope that GED VIZ (or possibly some descendant) eventually matures to a widely accepted tool helping many people to explore and share what globalization is really about.

¹⁴<http://atlas.media.mit.edu/>