VISUALISING SINGAPORE'S TRADE DATA

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Abstract

Singapore has continued to evolve as a popular choice for companies as they seek the advantage of a centralised trading hub experience, including a whole array of infrastructure and incentives: political stability, robust legal system, easy access to financial markets, attractive tax incentives, available talent and high-quality business infrastructure, as well as proximity to key Asian markets such as China, Japan, Korea and Australia.
- Cheng Voon Hoe, The Business Times Singapore [1]

Introduction

Singapore's location at the tip of the Malay Peninsula has long made it a vital hub for the trade of goods through the Straits of Malacca. As a city-state with scarce natural resources, international trade forms the lifeblood of this bustling country, while at the same time, forming its greatest vulnerability. This establishes the importance of understanding trade patterns, influenced by multiple macroeconomic factors, to safeguard the stability and future of the nation.

Various government bodies such as the Ministry of Trade and Industry (MTI) and Innovation and Enterprise (IE) Singapore pay close attention to these figures, continuously monitoring the trade numbers, its individual components and the countries that contribute to it. These figures are reported on annual and quarterly intervals, in the Economic Survey of Singapore [2]

The Straits Times regularly refers to trade figures as well when reporting trade-related news, such as the impact of free trade agreements (FTAs) or trading growth and decline of important trading partners.

With this close scrutiny from multiple key stakeholders, as well as general public interest in consuming this data, there is a need for a visualisation tool to quickly, clearly and concisely display this information for these agencies to analyse and report, and for the public to use.

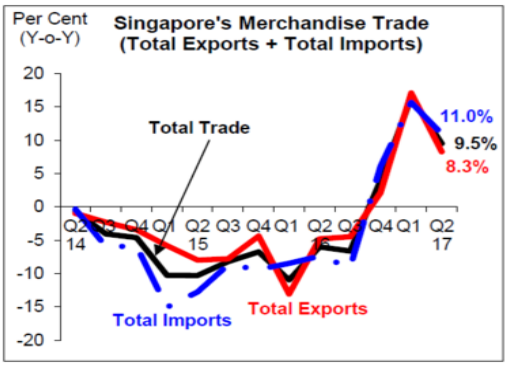
Related works and limitations

A large number of the existing trade visualisations prepared aim to display two types of information:

1. The growth trend of Singapore's trade over time, both imports and exports
2. The mix of Singapore's at different time periods, by trading partners

These visualisations are prepared on a quarterly basis by IE Singapore, MTI and on an on-demand basis by the Straits Times. This results in the public only being able to access the latest information in a visual format, when the reports are released.

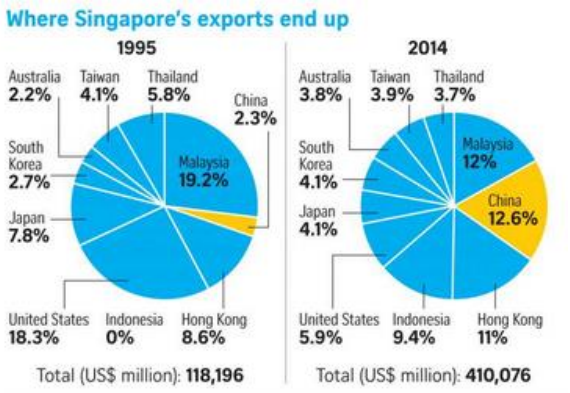
To visualise the time series trend of Singapore's trade over time, line charts are often used, such as in the example from MTI's economic survey of Singapore.



(Source: IE Singapore) [3]

However, a significant limitation of this visualisation is that country-level data is often omitted to simplify the chart. For additional analysis of trade by individual country, the visualisation has to be intentionally created with this country in mind. This greatly hinders public exploration and consumption of the data at a detailed level, unless they were to create their own charts themselves.

When reviewing Singapore's trade breakdown by country, the pie chart is The Straits Time's go-to visualisation to display this information.



(Source: The Straits Times) [4]

While a pie chart would be an easy and well-known way of visualising this data, there are several notable limitations:

1) Ability of only displaying one dataset - This results in the Straits Times having to report one pie chart each for overall trade, imports as well as exports. For comparison of two time periods, this requires six different pie charts.

   This large number of graphs results in difficult comparison of the various dimensions. For example, to uncover which country we have large amounts of exports to, buy fewer imports from, requires close scrutiny of the the charts.

2) Difficulty in viewing our trading partnes by rank - While the key message of this visualisation is that China has grown from our 7th largest export partner to the 1st in a span of 19 years, this information is not easily seen from from the chart, unless the reader is intentionally looking for it.

Motivation and Objectives

With the the existing visualisations and use cases in mind, and with particular reference to their limitations, we outlined the following key objectives for our data visualisation project:

<u>i) Versatility and Interactivity</u>
The visualisation must be able to display the information at the aggregated level, such as as Singapore's total exports and its growth, as this is the first and most commonly looked at figure.

However, our value-add to the existing works lies in the addition of country-level granularity on top of the aggregate figures, while keeping the visualisation uncluttered. This all-in-one approach aims to facilitate user-led discovery, giving the added benefit of allowing the public themselves to consume the data at a detailed level easily and quickly run comparisons between the various datasets, such as imports versus exports to a particular country.

<u>(ii) Usability by the public</u>
While our aim is to improve on the existing reports by agencies monitoring and reporting trade, we would also like to allow the public to lead their own exploration of the data, rather than wait for the agencies to select their own focus and report at this angle.

Through its versatility and interactivity, our visualisation provides the data visualised at a detailed level, ready for the public to extract the information that they need.

(iii) Familiar and Intuitive

With the widespread familiarity of the relevant agencies and the public with the use of line charts and pie charts to display this data, it is critical not to stray too far from these visualisation methods and completely alienate the user by introducing a visualisation that looks completely unfamiliar to them.

Data Collection, Exploration & Preparation

The first phase of data collection was an exploration of datasets that would give us the trade figures, including imports and exports, on a country level. We chose the dataset provided by CEIC Global Database [5], which compiles this information on a monthly basis.

As our focus was on visualising Singapore's trade, we chose to omit information on international trading patterns, such as trade data that does not involve Singapore.

In addition, we chose to keep to our focus on Singapore's international relations and foreign policy and its impact on trade, we chose to retain simplicity by reporting the data on a total exports and imports level.

This is in-line with our motivation of public usability of the visualisation, whose focus will be on the overall level and occasionally, country level. This avoids the user getting lost in the complexity of industry and country level trade data combined together.

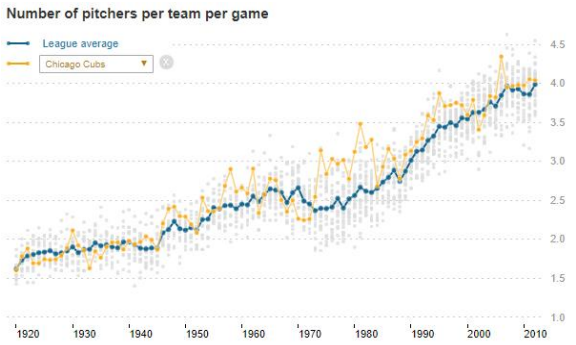
As such, we removed irrelevant data that does not belong to our focus on Singapore's trade. Data transformation is also done on the dataset to derive new information such as growth rate, together with the summation of data of various smaller trade countries to prevent chart clutter.

Our design considerations

Our team researched on various chart technologies and designs. Eventually, our team decided to work on the d3.js data visualisation library due to its wide variety of data visualisations examples published by the community, which some of them were open source that we could reference and improve from.

Furthermore, the loading of CSV files using its innate library is also asynchronous. In order to explore the different charts that would be suitable for the visualization of trade , much researching was done as such data/information are usually not represented using such customised charts and were mostly represented in simple line and pie charts just like what was shown previously.

Through our research on various data visualisation methods, we found two particular charts that were able to fulfill the objectives of our project. The first chart is a specialised line chart with elements of a scatter plot done for Baseball on The New York Times' sports section[6]. This chart allows will allow our users to understand the trade volumes or growth in relation to time, over the past 40 years of data that we have acquired from CEIC. The chart can also allow our users to perform a comparison of a specific country they are interested in with the overall trade data of Singapore in their analysis.

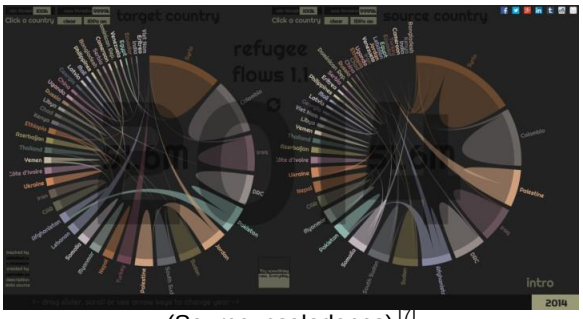


(Source: New York Times) [6]

The second chart is a Chord Diagram that we found on the various visualisation examples on the main page of D3.js. It was used in that example to show the flow of refugees between countries [7] and our team

realised that it could also be tweaked to show the flow of trade instead.

The chord chart will function much more than just a pie chart as it can not only display trade volume proportion among trading countries, but also allowing the user to look at the overall trade information for that particular year.



(Source: csaladenes) [7]

Certain information from the chord chart that would prove useful for our users would allow them to answer certain questions. These questions, includes whether Singapore, for that particular year:

- Has a trade surplus?
- The magnitude of the trade surplus/deficit?
- Our key trading partners

For specific bilateral trade between Singapore and a country of interest:

- Who is the net exporter?
- How much is the trade, in both imports and exports?
- What is percentage of that bilateral trade in comparison to the overall trade figure?

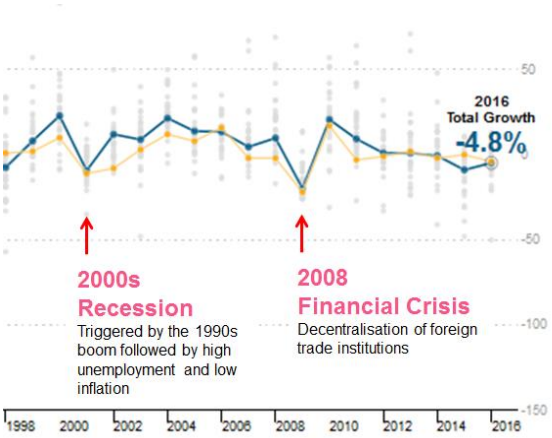
As such, with the amount of information that could be conveyed to our users from these two types of visualisation, our team decided to incorporate and focus on them in our application.

Use cases

(i) Reporting and analysis

By improving on the existing reports prepared regularly by MTI and The Straits Times, our data visualisation aims to replace the process of generating these reports by allowing analysts and reporters to interact with and customise the visualisation to their needs.

The ample space on the Trade Growth and Trade Value line charts gives room for annotations that can be used to complement the storytelling power of our visualisation.



A sample article on the story of China overtaking the United States as a trading powerhouse and strategic partner of Singapore can be found below

(ii) Providing our trade data for public use

Through Singapore's open data initiative, all these data can currently be accessed by the public. However, in its current format as a data table, the information is difficult to consume and requires time for the user to visualise for easier reading. The information is also needed to be customised for the use case of each individual.

As per our objectives, our data visualisation project places this open-access data at the hands of the public, for them to tailor to their specific analysis needs.

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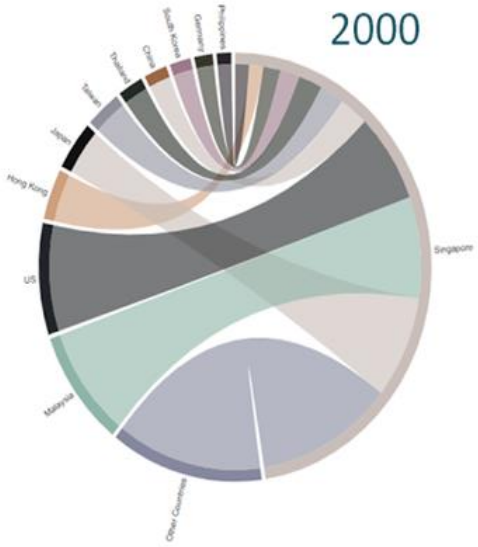
The Rise of China vs the United States

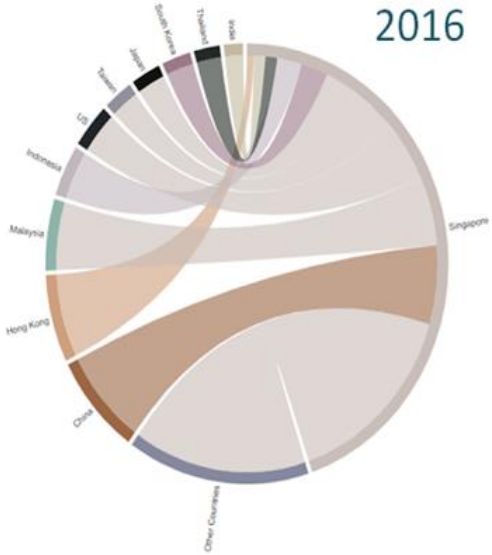
27 years into Singapore's official diplomatic relations with China, initiated in 1990, the island nation's foreign trade composition bears almost no resemblance to what it once was. We visualised this on the contributors chord charts (below), showing the drastic change in our main trading partners since the turn of the millennium.

While key players such as Malaysia and Hong Kong (a significant contributor to our trade balance) remain on the map, the glaring change lies in the rocketing of China from a small bar on the chord chart, to our largest trading partner.

Also worth noting is the changing nature of our relationships with these countries, where a coloured line denotes Singapore having a trade surplus with that nation – A much rarer sight today.



International Trade Flows 2000



International Trade Flows 2017

Taking a closer look at the trade growths of each country over the year, this outcome is hardly surprising. With China's trade growth with Singapore outpacing the total growth for the nation consistently, and US's trade growth lagging behind Singapore's total growth: this outcome could be easily seen.

Our trade over time chart (below) details the story of China rising to become our top trading partner

Conclusion

With the decline of the United States as the global economic powerhouse, as well as the threat of China's aggressive policy comes the increasing importance of Singapore maintaining its strategic partnerships across the globe. As a trading hub, a significant portion of these relationships revolve around trade policy and agreements.

As the Trans-Pacific Partnership (TPP) reaches a partial agreement post-US withdrawal[8], our visualisation tool will be useful in monitoring and displaying its impact on our trade in the years to come, whether successful or not, as well as the possible continued decline of the United States as a strategic trading partner, relative to the TPP nations.

Having visualised Singapore's current key trading relationships and events to-date, our data visualisation project provides the country's trade agencies, media companies as well as the public, a platform to effectively explore and analyse our trade data. This is broken down into its key aspects of trend over time as well as country mix, at a detailed country level of information that previously required the user to conduct his own data manipulation and visualisation.

Appendix

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6) Strikeouts on the Rise. (2013, March 28). Retrieved November 23, 2017, from http://www.nytimes.com/interactive/2013/03/29/sports/baseball/Strikeouts-Are-Still-Soaring.html

7) A visual exploratorium of refugee flows over the world using dynamic chord diagrams. (2015, June 22). Retrieved November 23, 2017, from https://csaladenes.com/2015/06/21/a-visual-exploratory-of-refugee-flows-over-the-world-using-dynamic-chord-diagrams/

8) Holmes, O. (2017, November 11). Trans-Pacific trade pact revived despite Trump withdrawal . *The Guardian*. Retrieved November 23, 2017, from https://www.theguardian.com/australia-news/2017/nov/11/trans-pacific-trade-deal-salvaged-despite-canada-u-turn-reports-say